NASA CR-135140

QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE)

Whirl Test of Cam/Harmonic Pitch Change Actuation System

by

Aircraft Systems Department, Propulsion Project Group

Hamilton Standard
Division of United Technologies Corporation

Under Subcontract to General Electric Company
(P.O. 200-4XX-14G38570)

(NASA-CR-135140) QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE) WHIRL TEST OF CAM/HARMONIC PITCH CHANGE ACTUATION SYSTEM Contractor Report, 10 Nov. 1975 - 16 Feb. 1976 (Hamilton Standard, Windsor Locks, G3/07

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Prepared For

National Aeronautics and Space Administration

NASA Lewis Research Center
Contract NAS3-18021

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Test Report, Project Manager, C.C. Ciepluch, QCSEE Project Office, Technical Advisor D.A. Sagerser, NASA Lewis Research Center, Cleveland, OH 44135

16. Abstract

A variable pitch fan actuation system, which incorporates a remote nacelle mounted blade angle regulator, was tested. The regulator drives a rotating fan mounted mechanical actuator through a flexible shaft and differential gear train. The actuator incorporates a high-ratio harmonic drive attached to a multi-track spherical cam which changes blade pitch through individual cam follower arms attached to each blade trunnion.

Testing of the actuator on a whirl rig, is reported. The tests were conducted to verify that the unit satisfied the design requirements and was structurally adequate for use in an engine test.

17. Key Words

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1.0 SUMMARY

The Hamilton Standard blade pitch change actuation system for the Quiet Clean Short Haul Experimental Engine (QCSEE) was tested on a whirl rig, at Hamilton Standard, between November 10, 1975 and February 16, 1976.

The objectives of the test were to verify that the unit satisfied the design requirements and was structurally adequate for use in an engine test.

The testing included evaluation of the travel limit switch, blade angle position accuracy, performance, frequency response, and endurance.

During tests of the travel limit switch it was found that the no-back output shaft was under-designed. Analysis of the shaft revealed that it could not be adequately strengthened within the space available. In order to reduce the load on the no-back, a snubber was installed in the actuator. When run with the snubber, no further distress was noted on the output shaft.

The testing showed that:

- Blade overtravel after actuation of the travel limit switch at maximum pitch change rate and zero fan speed was within the calculated value of 6.5-7.0 degrees.
- Blade angle can be positioned within 0.25 degrees when moving from open to close at zero fan speed and within 1.5 degrees at high fan speeds.
- There is approximately 1 degree of hysteresis in the system when reversing the direction of blade angle change at zero fan speed.
- The minimum attainable blade angle change was 0.17 degrees toward open and 0.26 degrees toward close.
- The maximum pitch change rate attained during a blade angle change was 135 degrees/second.
- Frequency response without the snubber indicated reasonable correlation with predictions at frequencies up to 1 Hertz where the magnitude ratio was lower and the phase shift was higher than at frequencies above 1 Hertz.

- **Frequency response with the snubber again indicated reasonable correlation with predictions at frequencies up to 1 Hertz with excitation magnitudes of ±8 ma, however with ±4 ma excitation the magnitude ratio was down and there was considerable phase shift.**

- **The actuation system successfully completed 500 simulated mission endurance cycles at pitch change rates up to 75 degrees/second and 50 cycles at pitch change rates up to 135 degrees/second.**

2.0 INTRODUCTION

During the proposal effort for the Quiet Clean Shorthaul Experimental Engine (QCSEE), a design study of ten prospective fan pitch change systems was conducted. The results of this study were reported in HSPC 74A14 QCSEE Variable Pitch Fan System Proposal. On the basis of this effort, four systems were selected for further study.

The detail study of the four systems was conducted under General Electric Purchase Order 200-4XX-14G31376. The results of the study were presented in SP 08A74 QCSEE Variable Pitch Fan Pitch Change System. The study showed that a system incorporating a remotely mounted Beta Regulator, driving a harmonic drive/cam actuator through a flexible drive shaft, was the most attractive. This type of system was designed, manufactured, and tested under NASA Contract NAS 3-18021. The results of the design effort were reported in NASA CR-134852 which also includes a summary of the preliminary design studies done on the other systems.

A second actuator was also developed by the General Electric Company. Details of the design of the General Electric actuator are presented in NASA CR-134873 "QCSEE Ball Spline Pitch Change Mechanism Design Report".

This report describes the whirl rig testing conducted on the system. The object of the test was to determine the operating characteristics of the actuator, verify that it satisfies the design requirements, and assure it's structural adequacy for use in an engine test.

3.0 SYSTEM DESCRIPTION

The variable pitch actuator system is shown in Figure 1. An electrical input command signal from the engine digital control to the electro-hydraulic servo valve (EHV) directs high pressure oil to motors in the beta regulator. This provides rotary mechanical input to the actuator differential gear train through a flexible drive shaft. Rotary motion is then transmitted through a no-back, harmonic drive, rotating cam, and cam follower arms to the blade trunnions. Since there is a fixed mechanical relationship between hydraulic motor rotation and blade angle, two linear variable differential transformers (LVDT) driven by motor output provide redundant blade angle feedback signals to the digital control to close the control loop and null the input signal when the blades reach the commanded position.

The overall gear ratio from the blades to the drive shaft is 1005:1 with most of the ratio (201:1) provided by a harmonic drive. This permits the low-torque power transmission elements between the beta regulator and the harmonic drive to be designed for low weight and improved blade angle accuracy.

The mechanical pitch change power and blade angle feedback functions are provided by the beta regulator module which is remotely mounted in a readily accessible area of the engine cowling. A simplified schematic of the beta regulator is shown in Figure 2. A blade angle change command from the engine control to the EHV mounted in the accessory section, causes movement of the servo valve to direct supply oil to either the open or close pitch ports of the hydraulic motor. The motor output drives the flexible shaft to change blade angle and drives two LVDT's through a worm gear and screw to provide an electrically redundant blade position feedback. Electrical limit switches are provided to cut off the command signal to the EHV if a blade angle is commanded beyond the maximum operating range. Pressure relief valves across the motor ports limit motor pressure to 3000 psi during rapid accelerations of the acutator system.

The rotary output of the beta regulator is transmitted to the actuator differential gear train through a flexible drive shaft passing through the engine reduction gearing. The shaft core is encased in a flexible teflon lined casing supported in a rigid conduit mounted on the engine reduction gear support. Continuous engine lubrication oil flow is directed through the casing from the beta regulator to lubricate the core and the actuator components.

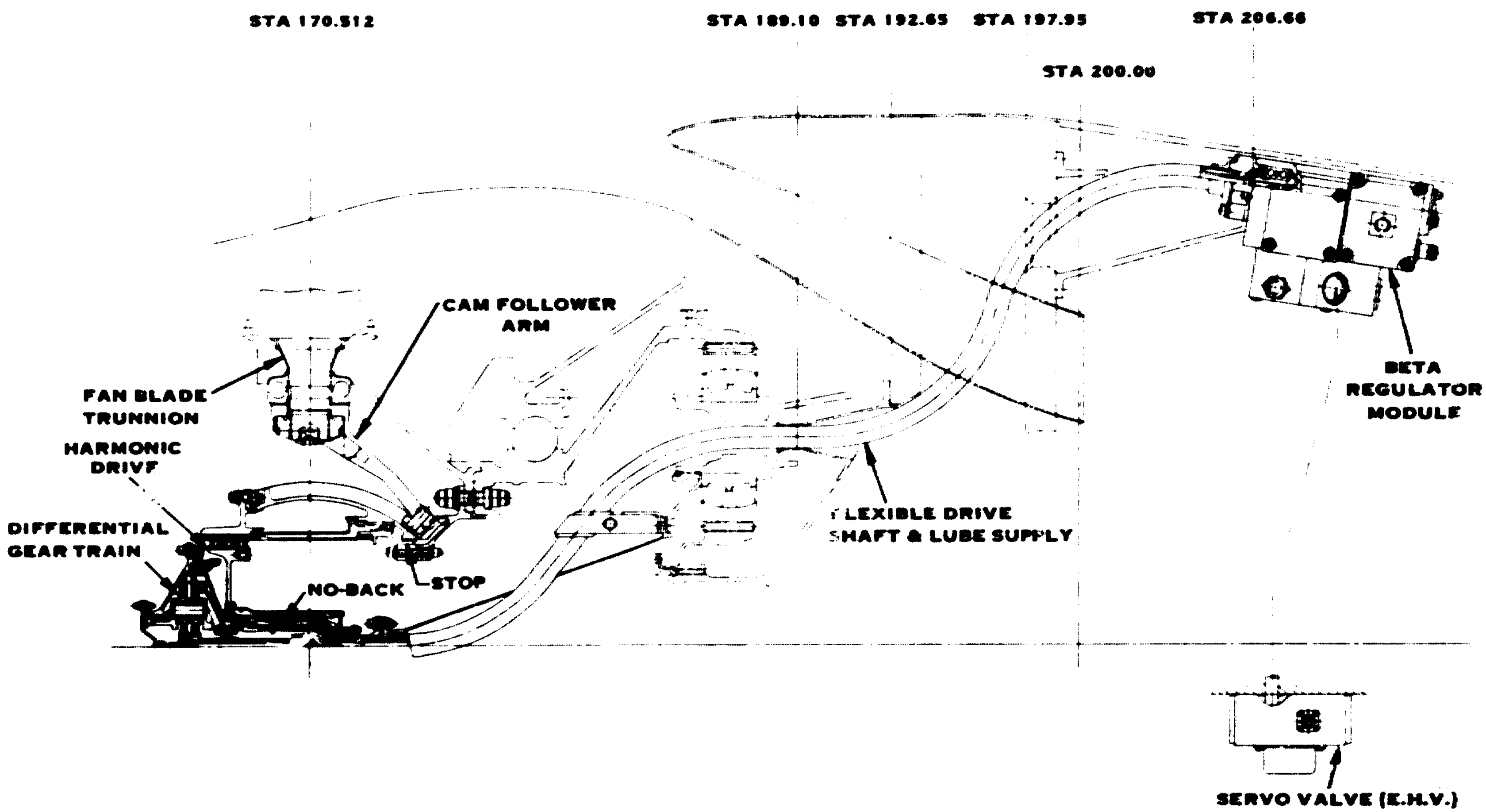

FIGURE 1. QCSEE VARIABLE PITCH ACTUATOR SYSTEM

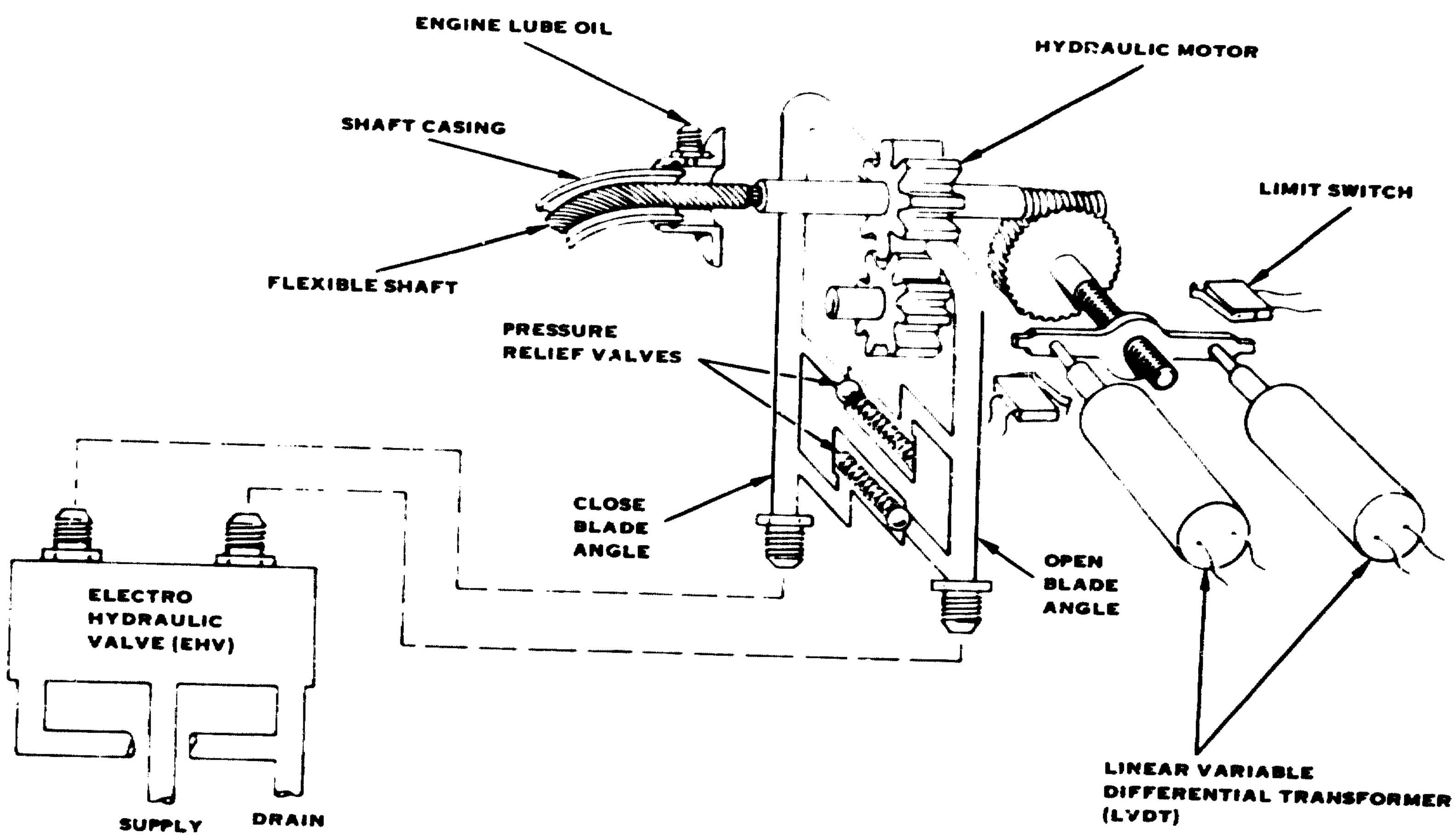

FIGURE 2. BETA REGULATOR SCHEMATIC

3.0 (Continued)

A planetary differential gear train is utilized to cross the rotating boundary of the fan. The differential gearing is a conventional 5:1 ratio phase difference type with a grounded sun gear, an input sun gear driven by the flexible shaft, three pairs of planet gears on a bearing supported cage, a reference speed ring gear fixed to the fan disk and an output ring gear driving the no-back input. With no pitch change input, the output ring gear rotates at fan speed. Rotation of the input sun gear during pitch change causes the output ring gear to either advance or recede with respect to the fan speed. This change in output is the input to the no-back. The gears and bearings are lubricated by oil directed outward centrifugally from the sun gear shafts.

A bi-directional spring clutch or "no-back" is provided between the differential gearing and the harmonic drive to maintain the set blade angle position in the absence of a pitch change command. This device consists of a self-energizing steel spring which is in contact with the inner surface of a fixed housing, the input and output shafts and the necessary couplings and bearings. When holding a fixed blade angle, the blade loads are transmitted to ground (housing) through the spring. When the input acts against opposing blade loads (raising the load), the spring slides in the housing and does not react to any blade loads. When the input acts against aiding blade loads (lowering the load), the input releases the spring at the commanded pitch rate and the blade load energy is dissipated in frictional heat between the spring and housing. Due to the short duty cycle and the thermal mass of the parts, the total heat rise is low in the no-back. Lubrication oil flows continually through the no-back and is supplied centrifugally from the sun gear shafts.

No-back housing torque is reacted by a disk-type torque limiter brake. The no-back is a high-gain locking device capable of locking more than a million in-lbs of torque at high friction coefficients, and the torque limiter limits maximum no-back torque to ground to acceptable structural limits during rapid pitch change decelerations. The brake disks are lubricated by oil supplied centrifugally from the differential gearing.

The harmonic drive provides the primary gear reduction for the mechanical actuator and increases the input torque to the level required to change pitch. Four basic elements are incorporated in this high-ratio (201:1) mechanical transmission rated at 50,000 in-lbs output. They are: a three-lobed harmonic-shaped wave generator input plug which provides the harmonic the harmonic lobe shape to the flexible spline, a triplex split inner race ball bearing set for high radial stiffness, a flexible spline (flex spline) to convert from

3.0 (Continued)

the harmonic lobe shape to a grounded circular shape with minimum frictional losses and a stiff circular output spline which drives the blade pitch cam.

The thin-race ball bearings are pressed on the three-lobed wave generator plug and assume the three-lobe harmonic shape. Spline teeth on the outside diameter of the flex spline mesh with spline teeth on the inside diameter of the circular spline at the three lobe locations. Circular splines on the other end of the flex spline ground it to the fan disk. Due to a 3-tooth difference in number of teeth between the circular spline and flex spline (603-600=3), one revolution of the wave generator input rotates the circular spline output 3/603 or 1/201 of a revolution.

Lubrication oil for the harmonic bearings and splines is supplied centrifugally from the differential gearing and no-back.

The cam and follower arms convert output rotation of the harmonic drive to fan blade angle change. Titanium follower arms, splined and clamped to the blade trunnions, engage individual cam slots in the spherical cam surface through cam rollers to synchronize the blades and sum the blade torques. The radial axis defined by the roller and cam track centerlines always intersects the fan axis of rotation at the same point similar to the apex point of a bevel gear mesh.

Cam support is provided by a preloaded duplex bearing set mounted on a support ring attached to the fan disk mounting flange for accurate balance control. Lubrication oil from the harmonic drive lubes the bearing set and is returned centrifugally to the engine scavenge area. A single dynamic oil seal with centrifugal venting precludes a dynamic pressure head.

Fixed mechanical stop lugs between the cam and cam support ring restrict the blades to 7° overtravel at each end of the maximum operating range.

4.0 RIG DESCRIPTION

Figure 3 is a drawing showing the arrangement of the whirl rig and the actuator.

The whirl rig used for the test was a modification of an existing rig. The rig utilizes a 186.4 kilowatts (250 horsepower) electric motor to drive the fan through an eddy current clutch and a speed increasing gearbox. The connecting shaft between the gearbox and the actuator has a flange which dimensionally duplicates the actuator/ disk mounting surface in the engine. The flange also provides a path for the removal of the lubrication fluid.

A disk together with trunnions, stub blades (counterweights), and other retention hardware was provided for the test by General Electric. The stub blades are designed to apply the same centrifugal load to the blade retention and the actuator as the actual blade, and to approximate the twisting moment of the actual blade. Figure 4 is a curve of twisting moment versus blade angle for the actual and the stub blade. Stub blades were used for the test as they do not produce thrust and therefore can be driven by a relatively small motor.

Initial attempts to run the rig revealed the need to provide a shroud to enclose the stub blades and their retention to reduce the windage losses and consequently the power required to drive the assembly and the noise level in the vicinity of the test rig.

In the engine, the Beta Regulator is mounted behind the actuator and the flex shaft is routed through the engine gearbox to the actuator. To duplicate this arrangement on the whirl rig would require a hollow connecting shaft between the speed increaser gear box and the actuator, a hollow shaft through the gear box, and a quill shaft between the flex cable and the pitch change input at the actuator. This approach was investigated and discarded as it added another spring rate to the pitch change input system (the quill shaft), as well as being expensive and time consuming to obtain a hollow shaft gearbox.

Instead, a set of test hardware which provided a front input to the actuator for the flex cable was designed and manufactured. This hardware does not affect the spring rate of the input system. Figure 5 is an assembly drawing of the front input hardware.

In an engine installation, the lubricating and pitch change fluids are supplied by an engine driven pump. For the whirl test, a Viking pump rated at 18.9 liters/min (5 gpm) at 68.9 newtons/cm^2 (100 psi) was used to supply the

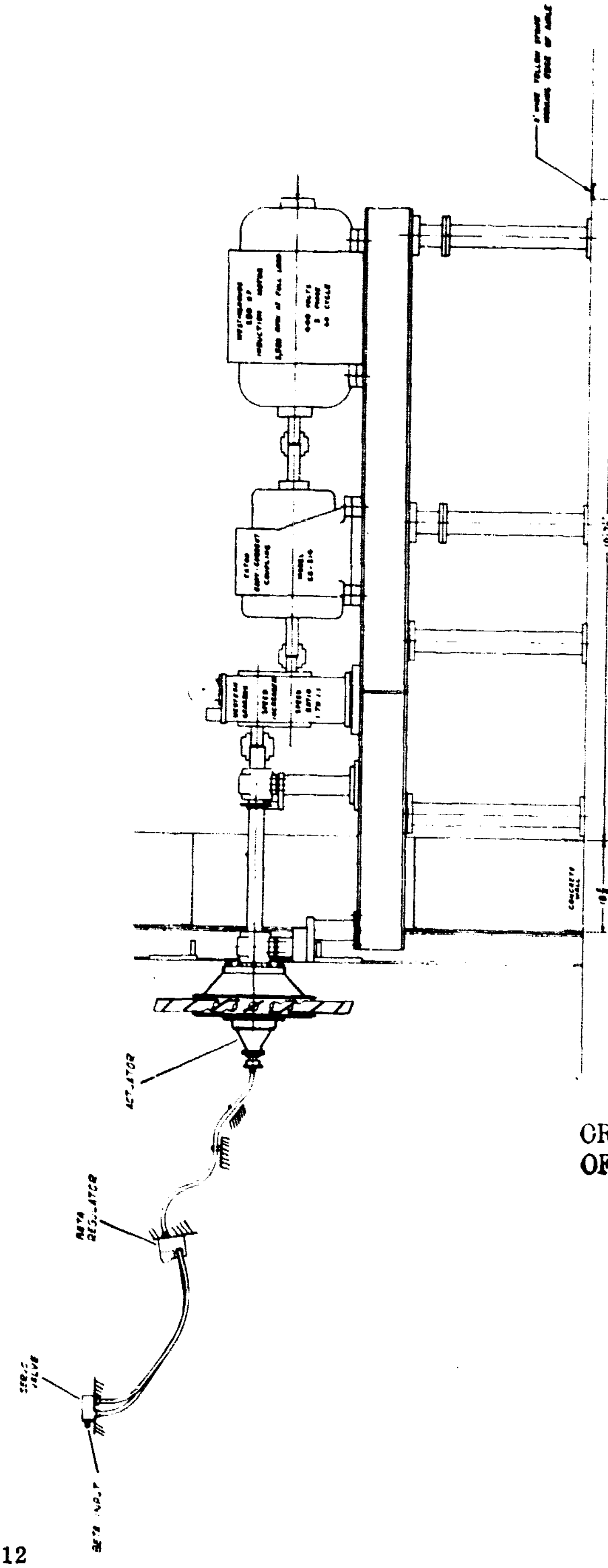

FIGURE 3. WHIRL RIG ARRANGEMENT

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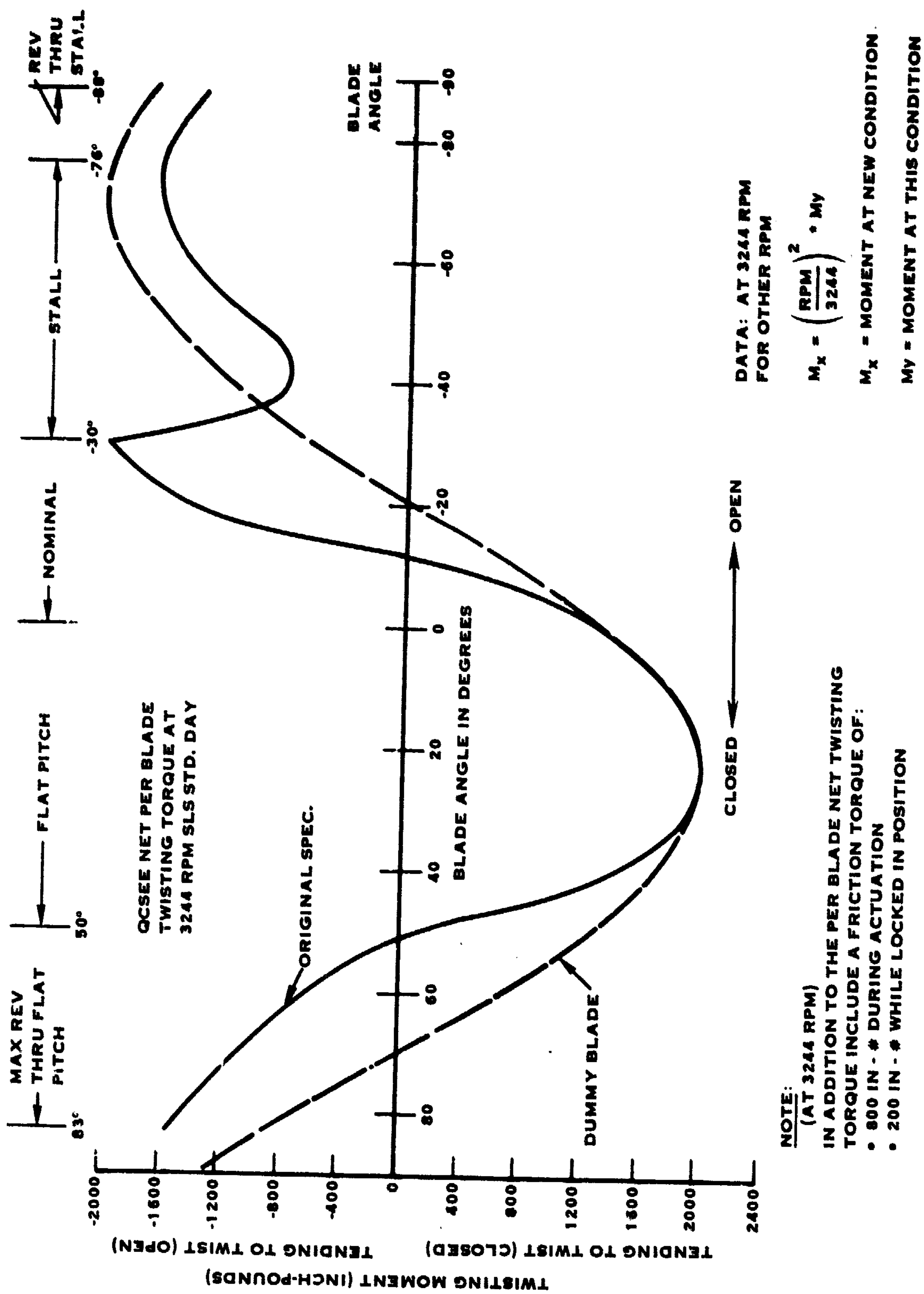

FIGURE 4. MAX NET TWISTING MOMENT

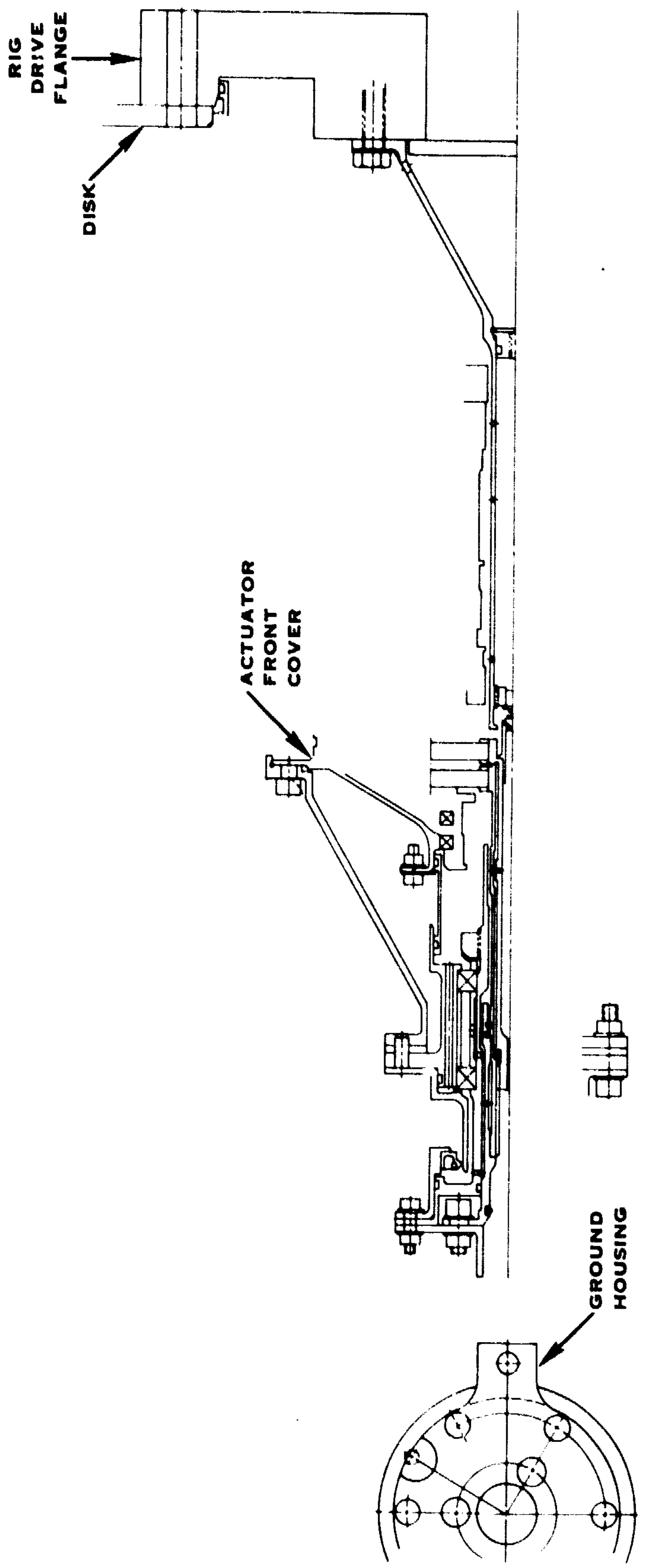

FIGURE 5. ASSEMBLY, FRONT INPUT HARDWARE

4.0 (Continued)

lubricating fluid. Initially, it was planned to use one Denison pump rated at 132.5 liters/min (35 gpm) at 3447.4 newtons/cm^2 (5000 psi) to supply change fluid for the majority of the testing, and to use a Denison pump rated at 94.6 liters/min in parallel with it for testing requiring high flow. (maximum pitch change rates). Operating the two pumps proved to be quite difficult, so the second pump was replaced by an accumulator.

The instrumentation provided for the test is listed in Table I. The flex shaft speed was measured by machining a six tooth wheel on the feedback shaft in the beta regulator, and installing a magnetic pickup in the beta regulator housing.

The flex shaft torque was measured by strain gaging and calibrating the ground sun gear in the actuator.

Actual blade angle was measured using photo diode sensors to measure the relative position of the actuator cam and the disk. The output of the sensors was read by a phase meter.

Figure 6 is a photograph of the whirl rig installation.

A closed loop variable gain control system, modified from an existing unit, was used to operate the actuator.

The rig was operated in accordance with Operating Procedure 222PT-37. A copy of this procedure is included in Appendix A.

TABLE I
INSTRUMENTATION LIST

Measurement	Range	Accuracy
EHV Supply Pressure	0 - 4000 psig	± 40 psi
EHV Current Signal	± 100 ma	± 2.25% of reading
Flow to EHV	0 - 45 gpm	± 2.83% of full scale
ΔP Across-Motor	0 - 3500 psig	± 2.25% of full scale
Temperatures	0 - 300°F	± 2°F
Blade Angle Command	+20 to -120°	± 2% of full scale
LVDT Feedback Voltage	± 5 V dc	± 2% of full scale
Flex Shaft Speed	0 - 24,000 rpm	± 2.83% of full scale
Flex Shaft Torque	0 - 200 in lb	± 2.83% of full scale
Lube Oil Flow	0 - 1 qt/min	± 2% of reading
Lube Oil Pressure	0 - 100 psig	± 1 psi
Fan Speed	0 - 3700 rpm	± 2% of full scale
Vibration - Horizontal	0 - 30 mils	± 5% of reading
Vibration - Vertical	0 - 30 mils	± 5% of reading
Fan Blade Angle	+20 to -120°	± 0.2°

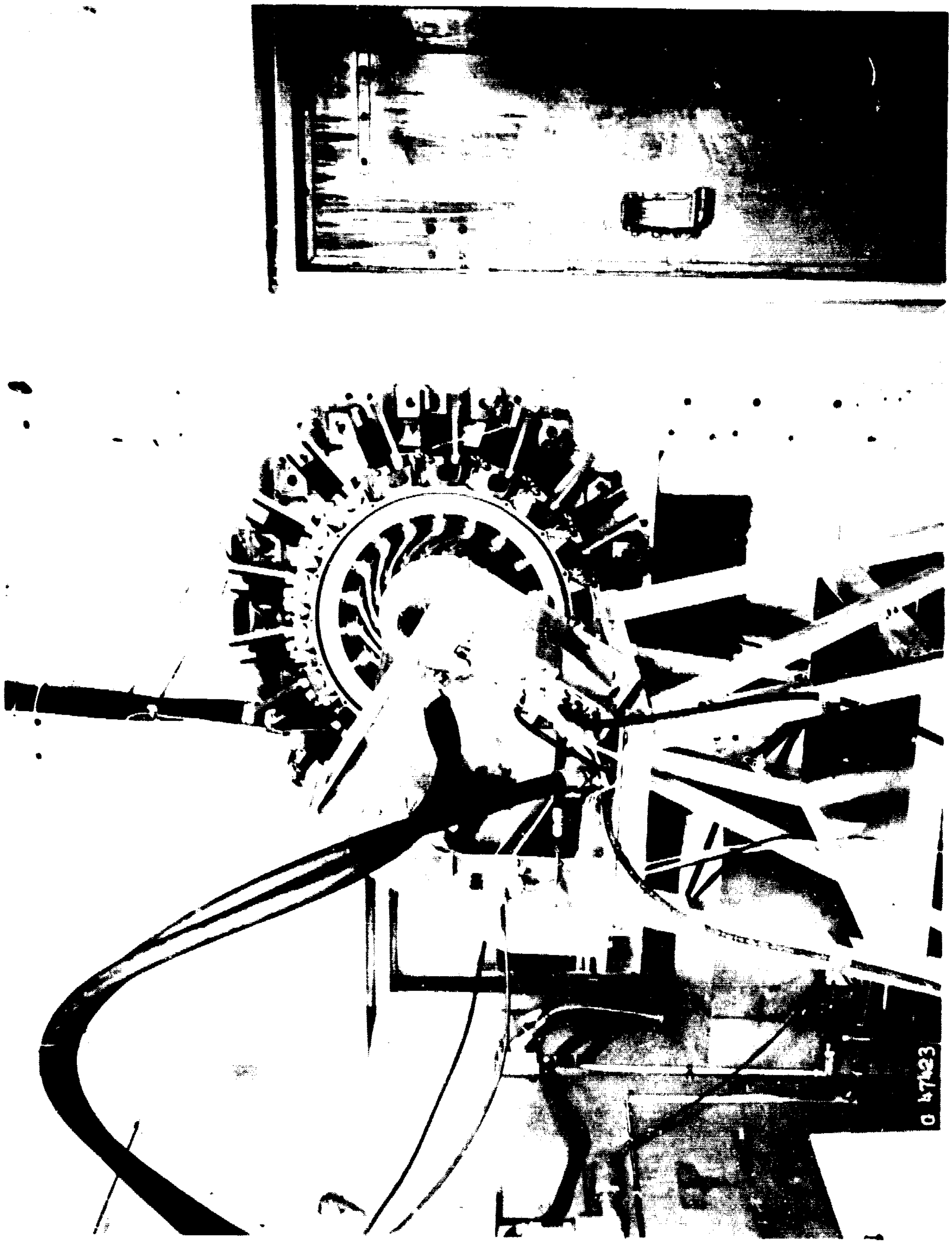

FIGURE 6. ACTUATOR IN WHIRL RIG

5.0 TEST PROCEDURE

The test was conducted essentially in accordance with Plan of Test 222PT-31 Rev. A. A copy of this plan is included in Appendix B. Variations from the Plan of Test are described below at the appropriate point in the test procedure description.

The test points in the plan are defined in terms of fan blade angle to be compatible with the specification. However, the stub blades supplied by General Electric were offset 25° relative to the blade angle in order to properly locate the peak twisting moment loads on the actuation system and a portion of the test data was recorded in terms of counterweight angles. The data is marked blade angle or counterweight angle, as appropriate, and the relationship between the two is that blade angle plus 25° equals counterweight angle. For the test, the counterweights were reindexed 2 spline teeth (18.5 degrees) from the design condition. This was done at the direction of General Electric to obtain more reverse blade angle.

The lubrication flow check was conducted with the flex shaft disconnected from the actuator. The flow from the shaft was measured at varying inlet pressures. Inlet pressure was measured at the pump.

The test was later repeated measuring the pressure at the inlet to the regulator and measuring the flow at the inlet to the flex shaft.

The LVDT null and calibration test was accomplished by changing blade angle with the manual pitch change input and measuring the counterweight angle. The blades were moved from "close" to "open" only.

The travel limit switch tests were accomplished by setting the controller to give a step command of approximately 30-40 degrees of blade angle which would actuate the travel limit switch. The pitch change rate was varied by regulating servo valve supply pressure and flow. The amount of overtravel was determined by physical measurement of the angle at which the counterweights stopped, compared with the angle at which the switch actuated. The testing was conducted at 0 fan rpm.

During early testing it was found that operation at the maximum pitch change rate overstressed the no-back output shaft. In order to continue testing, the maximum pitch change rate was limited to 75 degrees/second.

Initial running revealed a rig resonance at approximately 2500 fan rpm. To avoid this resonance, all testing specified at 2500 rpm was conducted at 2700 rpm.

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5.0 (Continued)

The position accuracy test was conducted by setting blade angle with the controller and measuring actual blade angle. Because of the instrumentation accuracies in this test (controller setting, actual blade angle readout) an alternate static positioning accuracy test was also run. In this test, the blade angle feedback (LVDT's) were positioned with the manual input and the actual blade angle change was measured by a dial indicator and converted to angle change.

The test to determine the pressure and flow required to start and sustain actuator motion was conducted by commanding the desired change with no pressure to the servo valve, and then increasing the pressure to the valve until the blade angle change was complete.

The test to determine the minimum blade angle change around 0° was conducted by slowly changing the controller input until a change in LVDT feedback voltage was observed. The actual counterweight position was measured to determine that the blades had moved.

Frequency response testing was conducted with a two channel transfer function analyzer with automatic gain and sweep control and direct plot output. For the static testing, blade angle was measured by a proximity pickup set up on one of the stub blades.

The endurance test was conducted in accordance with Table II. The forward thrust test points were set manually, the modulating thrust points were run using an oscillator input to the controller, and the reverse/unreverse transients were step inputs to the controller. Initial cycles were conducted at approximately six per hour to preclude overheating the no-back. Since experience showed no evidence of heating on the no-back spring, the remaining cycles were conducted at a rate of ten to twelve per hour.

Following testing in accordance with Plan of Test 222PT-31 Rev. A, the actuator was modified by the addition of a snubber. Testing in accordance with Plan of Test 222PT-38 was then accomplished. A copy of this plan is included in Appendix B.

TABLE II
QCSEE ACTUATOR

Speed (rpm)	Blade Angle	DC Command Pot Setting	Feedback Gain	Step Command	
				Set	Cond.
2700 (#3)	12°	309	325	9.81	ON
2700	-3°	205			
3408 (#1)	-3°	205			
3408	0	230			
3068 (#2)	0	230			
3068	+7°	269*			
	+5°				
	+7°				
	+9°				
3068	+7°	269*			
3068	+7°	272			ON
3068	-100°	272			OFF
3408 (#1)	-100°	272			OFF
2700 (#3)	-100°	272			OFF
2700	+7°	272			ON
2700	+12°	301	325	9.81	ON

*Plug in Function Gen. - Amp - Min
Freq - Range 0.1
Dial 1.9

Don't Forget to go to 2700 Prior to Unreverse.

≈ 10 min/cycle

5.0 (Continued)

These tests were conducted in the same manner as the tests of Plan of Test 222PT-31 Rev. A with the exception of the frequency response test. This test was conducted with a single channel transfer function analyzer. This unit did not have automatic gain and sweep control, or direct plot capability. The following test points were run rather than those listed in the plan of test.

Frequency (cps)	Servo Valve Current (ma)
0.5	± 4 ± 8
1.0	± 4 ± 8
2.0	± 4 ± 8 ± 12
3.0	± 4 ± 8 ± 16

6.0 TEST RESULTS

Structural

During the test the following structural problems were noted with the hardware.

During the initial tests of the travel limit switches, after six actuations at pitch change rates up to 82 degrees/second, it was found that the no-back output shaft had fractured at the webs between the three windows. Figure 7 is a photograph of the shaft. The fracture of the shaft was attributed to the shaft being under-designed in this area for the expected load of 271.1 newton meters (2400 inch pounds). The shaft was repaired by electron beam welding, and "beefed" up in the area where it had fractured. In addition a new shaft was fabricated incorporating additional strengthening. The welded shaft (763494-1/222X575) was approximately twice as strong and the new shaft (763494-1 Chg. B) was four times as strong as the design which fractured. Figure 8 is a comparison of the three configurations.

Testing was resumed with the welded output shaft. Performance tests, including some running at high pitch change rates, and a total of 46 flight cycles were completed. The unit was disassembled for a routine inspection, and the welded output shaft was found to be fractured in two of the three webs.

Analysis of this incident revealed that the original design of the shaft did not take into account the torque generated by inertia of the no-back drum and brake hardware which must be accelerated up to speed when the actuator starts slowing down.

At pitch change rates of 135 degrees per second, this inertia raises the load on the shaft to 536.6 newton meters (4750 inch pounds). Further analysis revealed that even with the inertia reduced as much as feasible in the existing design, the output shaft could not be strengthened sufficiently within the space available. Consequently, testing with the new shaft was limited to a pitch change rate of 75 degrees per second.

After completion of 500 flight cycles, the new shaft (763494-1 Chg. B) was found to be cracked in the web area. Investigation of this incident including a static torque test of the system, revealed that the spring rate of the system was 5648.7 newton meters per radian (50,000 inch pounds per radian) rather than the calculated 2824.4 newton meters per radian (25000 inch pounds per radian). The higher spring rate raises the expected 271.1 newton meter load on the shaft at 75°/second pitch change rate, to 451.9 newton meters (4000 inch pounds).

FIGURE 7. 763494-1 OUTPUT SHAFT

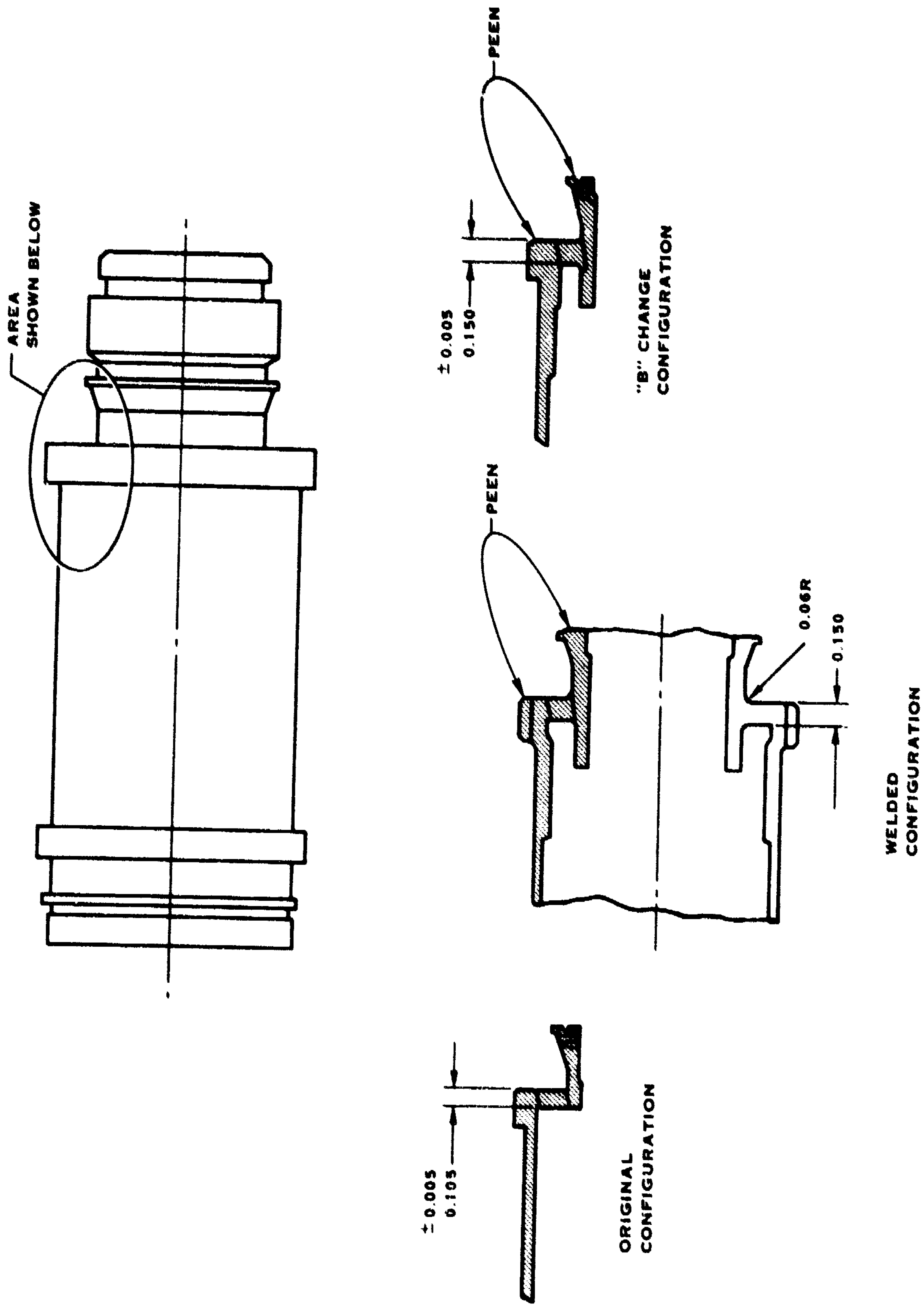

FIGURE 8. OUTPUT SHAFT COMPARISON

6.0 (Continued)

The difference between the calculated and actual system spring rates is the result of the coefficient of friction assumed between the no-back spring and the no-back drum. In the calculations, a lower than actual coefficient was used. This results in more engaged spring coils to absorb a given torque resulting in a greater spring deflection, and therefore a lower no-back spring rate.

To restore the actuators maximum pitch change rate capability, a snubber was designed and fabricated to reduce the spring rate of the system to 677.8 newton meters per radian (6000 inch pounds per radian), which reduced the output shaft load to 271.1 newton meters at the maximum pitch change rate of 135°/second.

Incorporation of the snubber results in the following life predictions for the output shaft and the snubber:

Maximum Flex Shaft Speed (rpm)	17,500	21,000
Snubber Fatigue Life (cycles)		
at room temperature	> 1,000	750
at 93.3°C (200°F)	1,000	500
Output Shaft Fatigue Life (cycles)		
at room temperature	5×10^4	1.5×10^4
at 93.3°C (200°F)	2.1×10^5	1×10^5

At the same time that the snubber was installed in the actuator, the no-back spring was replaced with a new part. This was done as a precautionary measure as the original spring had been subjected to higher than design loads during operation without a snubber.

Prior to, and following the testing of Plan of Test 222PT-38, the spring rate of the snubber was measured. The initial measurement revealed the actual spring rate to agree closely with the calculated rate (684.4 newton meters per radian [6067 inch pounds per radian] vs. 698.2 newton meters per radian [6180 inch pounds per radian]). The after testing check revealed no change in spring rate or other deterioration of the snubber.

6.0 (Continued)

During the initial spring rate check of the snubber, its deflection versus load was calibrated. A means of indicating relative motion during actuator operation was added to the snubber, and the deflection checked at various pitch change rates up to maximum. These measurements indicated that the snubber limited the load on the output shaft to the design value of 293.7 newton meters (2600 in lbs).

It was observed during the test that the wear pattern on the cam tracks was high in the track on one side, and low on the other. Inspection of the cam revealed that the sides of the tracks were not parallel to a radius through the center of the track. Subsequent running over the full range of speeds and loads has shown that this small abnormality in the pattern does not represent a significant problem and no corrective action was taken.

As a result of an assembly error, the rear support housing was fractured in the 'O' seal groove area that mates to the engine. This fracture extended about 3 inches circumferentially at the aft edge of the seal groove. The housing was repaired by removing the damaged area, electron beam welding a new ring onto the back of the housing, and remachining.

During the lubrication flow check it was found that oil leaked through the outer casing of the flex shaft at the junction with the end fittings. This was found to be a result of a drawing error which did not call for the teflon lining in the casing to be swaged between the casing and the end fittings. The second flex cable leaked slightly at the junction of one end fitting and the casing. This was attributed to a poor joint at the swage of the casing to the end fitting. For rig running, the conduit was sealed at the actuator and the drain hole plugged to contain the leakage.

At the completion of testing, the flex shaft core was deformed, apparently as a result of having been over-torqued. The distortion of the core during the over-torque also deformed the casing. Reference Figure 9. The over-torque was attributed to a shutdown during the travel limit switch tests from a pitch change rate of 130 degrees per second with a controller time constant of 10 milliseconds. The controller was modified to a time constant of 25 milliseconds, (system designed for 20-30) and subsequent shaft torques were measured to be within acceptable limits.

During the inspection following the completion of testing per 222PT-31 Rev. A, pitting and scoring were noted on the bevel gears and their pinion. The data received with the bevel gear set from the manufacturer had shown the final grind pattern to be marginal.

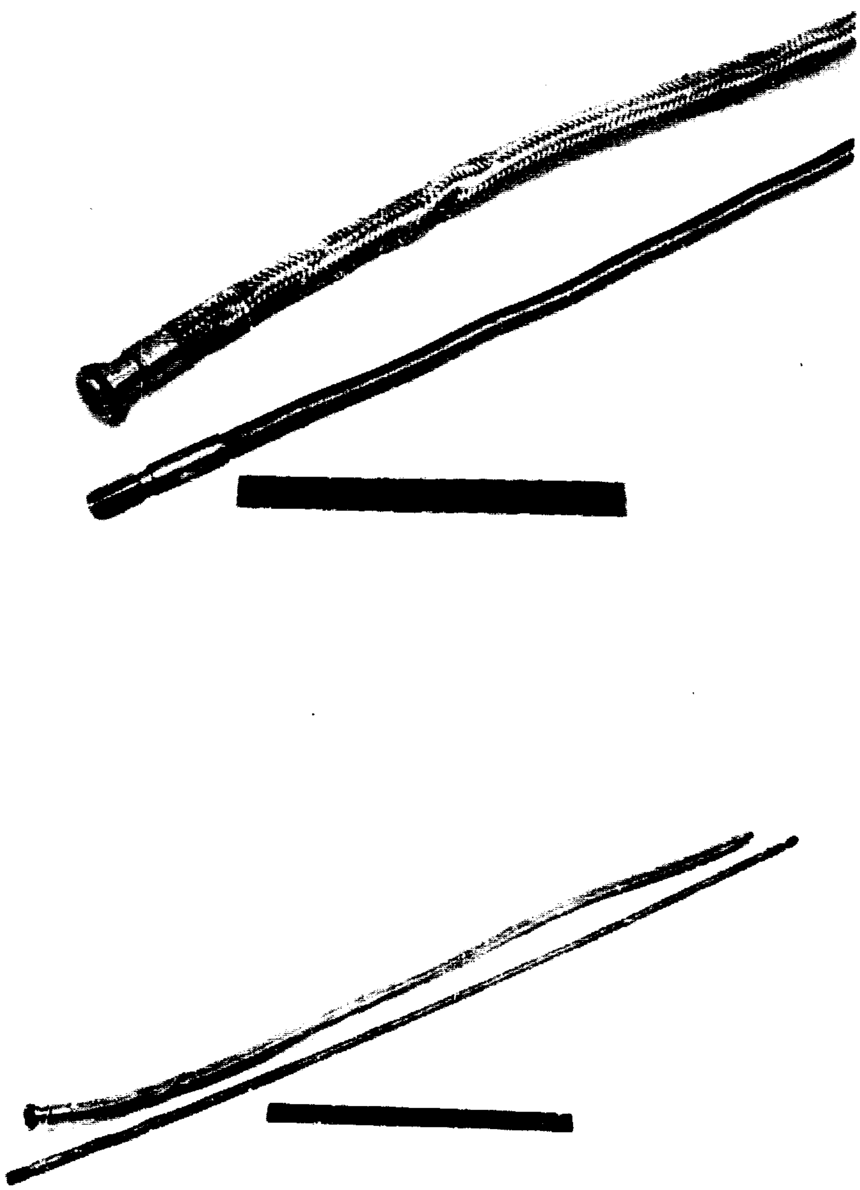

FIGURE 9. 763402-1 FLEXIBLE SHAFT

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6.0 (Continued)

During the course of the test, the gear pattern had been examined several times and always appeared to be high on the tooth. Consequently, the shimming of the pinion and gears was changed several times to bring them closer into mesh. As the parts are brought closer into mesh the backlash is reduced. The lubrication system for the beta regulator was designed to provide a mist to lubricate the gear mesh. As the backlash was reduced, this method of lubrication apparently became marginal. The gear set was replaced, and the regulator reworked to provide an oil jet which sprays directly into the gear mesh. The mesh was shimmed to insure sufficient backlash rather than attempting to center the pattern on the tooth.

During the disassembly of one of the hydraulic motors for inspection, the bearing housing was damaged by a faulty disassembly procedure. This motor was replaced by a new motor. Following the completion of the flight cycles conducted with the snubber, an attempt was made to conduct the frequency response test. With an input to the servo valve of ± 4 ma, no response was obtained from the actuator. The hydraulic motors were disassembled for inspection, and the new motor was found to exhibit heavy wear on the housing bore at the drive gear face. Dimensional inspection revealed no reason for this wear. Another motor was installed in the regulator, and the actuator then responsed to current inputs to the servo valve of ± 4 ma.

All other hardware in the actuator and the regulator was in good condition following the tests. The hardware was subjected to magnaflux, zyglo, and visual inspection following the completion of testing per Plan of Test 222PT-31 Rev. A, and visual inspection following testing per Plan of Test 222PT-38.

Performance

The lubrication flow check revealed that it took 63.8 newtons per square centimeter (92.5 pounds per square inch) at the lubrication pump to obtain a flow of 0.80 liters per minute (0.85 quarts per minute) out of the flex shaft. Figure 10 is a plot of the data taken during this test. A second check was made to determine the pressure required at the inlet to the regulator to obtain the required flow. This test showed that it took 42 newtons per square centimeter (61 pounds per square inch) to achieve the desired flow. The design value was 48 newtons per square centimeter (70 pounds per square inch). Figure 11 is a plot of the data taken during this test.

The results of the LVDT calibration tests showed the output voltages from the two LVDT's to be in close agreement. Table III is a summary of the data taken during the test where the blades were moved from "close" to "open", and Figures 12 and 13 are plots of output voltage versus blade angle.

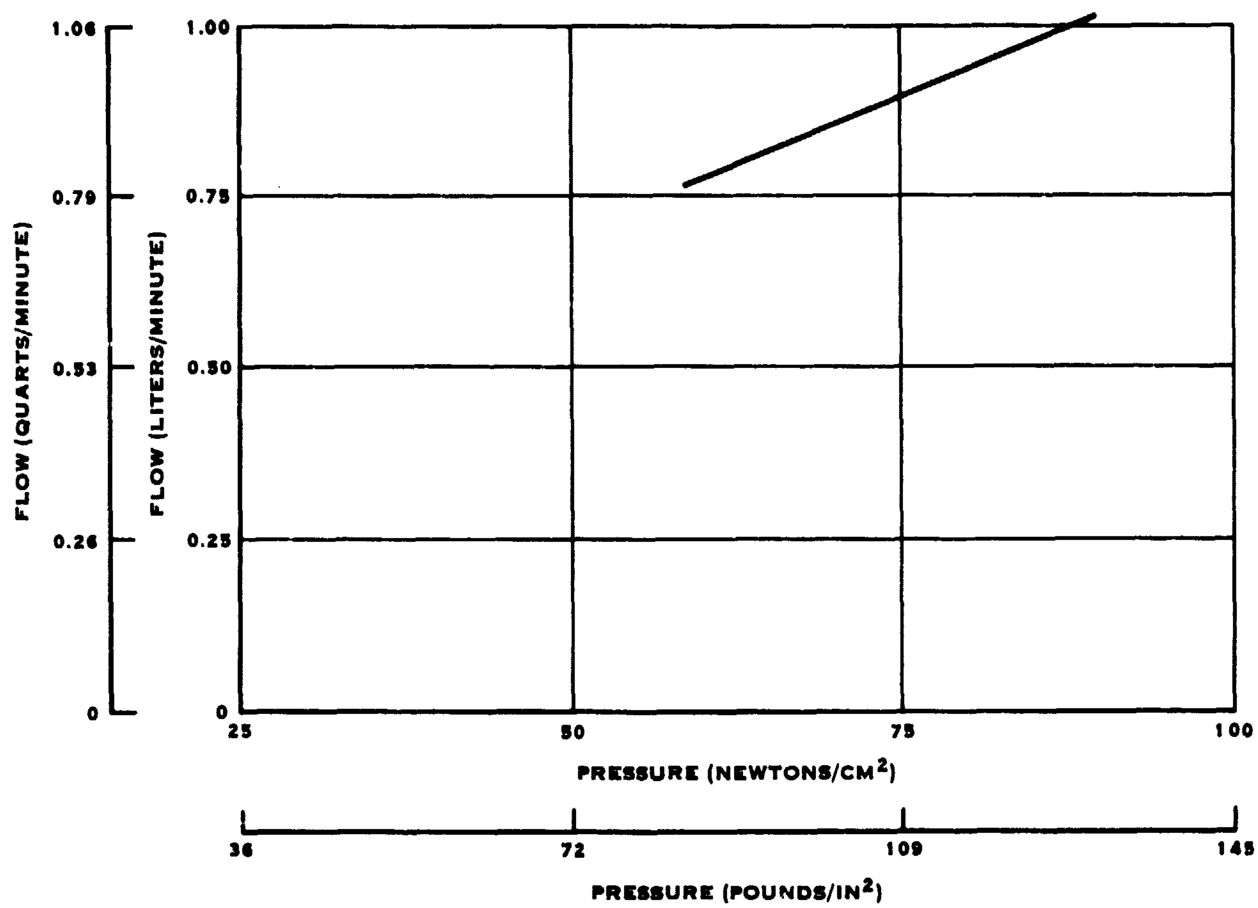

FIGURE 10. LUBRICATION FLOW CHECK FLOW VS. PRESSURE AT PUMP 11-10-75

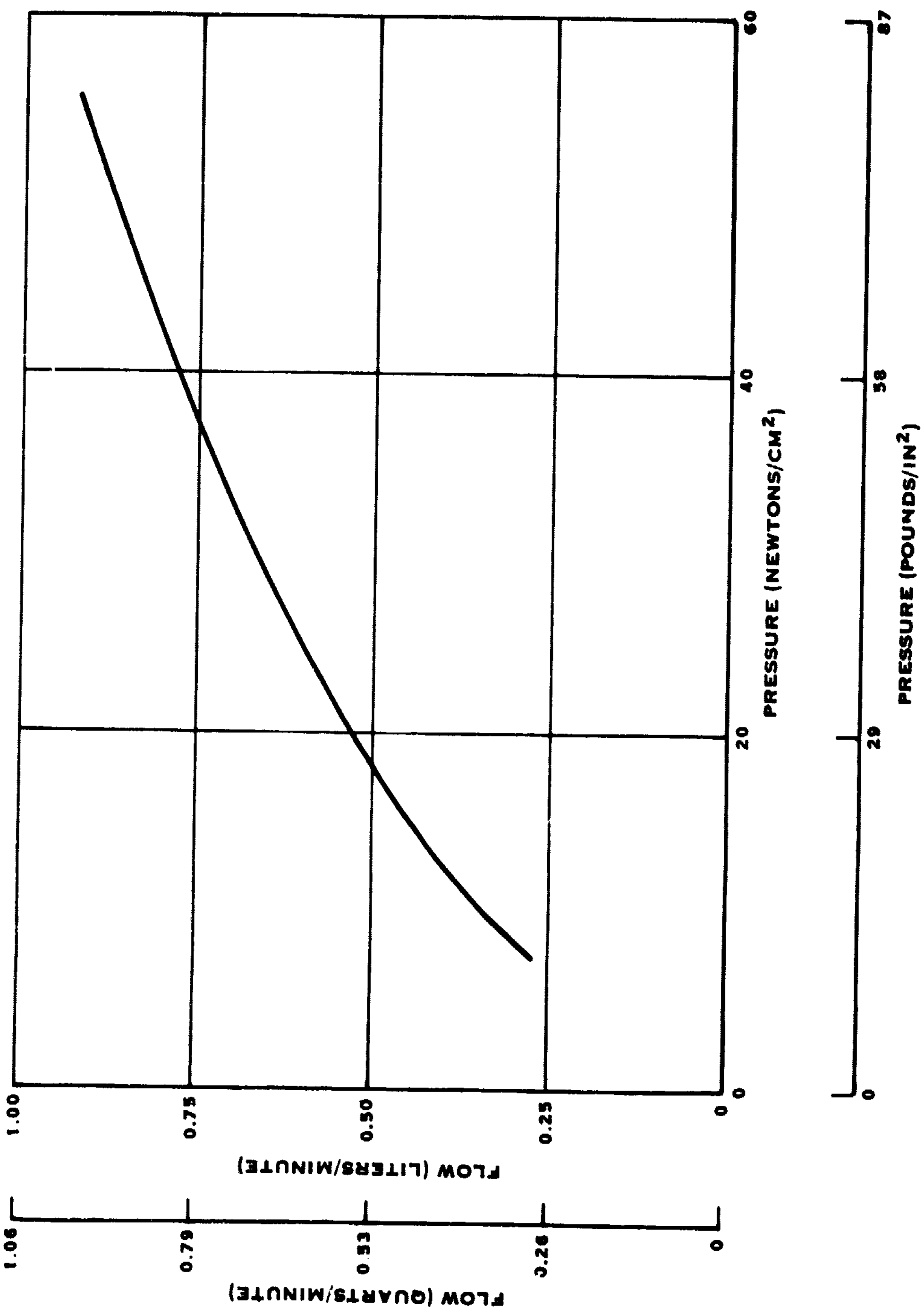

FIGURE 11. LUBRICATION FLOW CHECK - FLOW VS. PRESSURE AT REGULATOR 1-14-76

TABLE III
LVDT CALIBRATION

DATA FROM 11-10-75

Counterweight Angle	Blade Angle	Excitation Voltage	Output Voltage Total		Output Voltage Volts/Volt	
			LVDT1	LVDT2	LVDT1	LVDT2
*42.2	17.2	5.666	2.373	2.371	0.419	0.418
35.0	10.0	5.665	2.107	2.105	0.372	0.372
30.0	5.0	5.667	1.907	1.905	0.337	0.336
25.0	0	5.664	1.715	1.711	0.303	0.302
20.0	- 5.0	5.666	1.513	1.509	0.267	0.266
15.0	-10.0	5.667	1.307	1.305	0.231	0.230
10.0	-15.0	5.665	1.094	1.091	0.193	0.193
5.0	-20.0	5.666	0.893	0.890	0.158	0.157
0	-25.0	5.665	0.706	0.704	0.125	0.124
- 5.0	-30.0	5.665	0.518	0.517	0.091	0.091
-10.0	-35.0	5.666	0.345	0.342	0.061	0.060
-15.0	-40.0	5.665	0.184	0.183	0.032	0.032
-20.0	-45.0	5.664	0.034	0.033	0.006	0.006
-25.0	-50.0	5.665	-0.121	-0.121	-0.021	-0.021
-30.0	-55.0	5.665	-0.265	-0.265	-0.047	-0.047
-35.0	-60.0	5.665	-0.425	-0.425	-0.075	-0.075
-40.0	-65.0	5.665	-0.575	-0.574	-0.102	-0.101
-45.0	-70.0	5.665	-0.725	-0.725	-0.128	-0.128
-50.0	-75.0	5.665	-0.875	-0.873	-0.154	-0.154
-55.0	-80.0	5.665	-1.027	-1.027	-0.181	-0.181
-60.0	-85.0	5.665	-1.190	-1.187	-0.210	-0.210
-65.0	-90.0	5.665	-1.353	-1.351	-0.239	-0.238

TABLE III (Continued)
LVDT CALIBRATION

DATA FROM 11-10-75

Counterweight Angle	Blade Angle	Excitation Voltage	Output Voltage Total LVDT1	Output Voltage Total LVDT2	Output Voltage Volts/Volt LVDT1	Output Voltage Volts/Volt LVDT2
-70.0	-95.0	5.665	-1.520	-1.514	-0.268	-0.267
-75.0	-100.0	5.665	-1.686	-1.683	-0.298	-0.297
-80.0	-105.0	5.665	-1.850	-1.847	-0.327	-0.326
-85.0	-110.0	5.665	-2.007	-2.003	-0.354	-0.354
-90.0	-115.0	5.665	-2.153	-2.150	-0.380	-0.380
-95.0	-120.0	5.665	-2.290	-2.284	-0.404	-0.403
*-98.7	-123.7	5.665	-2.382	-2.378	-0.420	-0.420

*Mechanical Stop

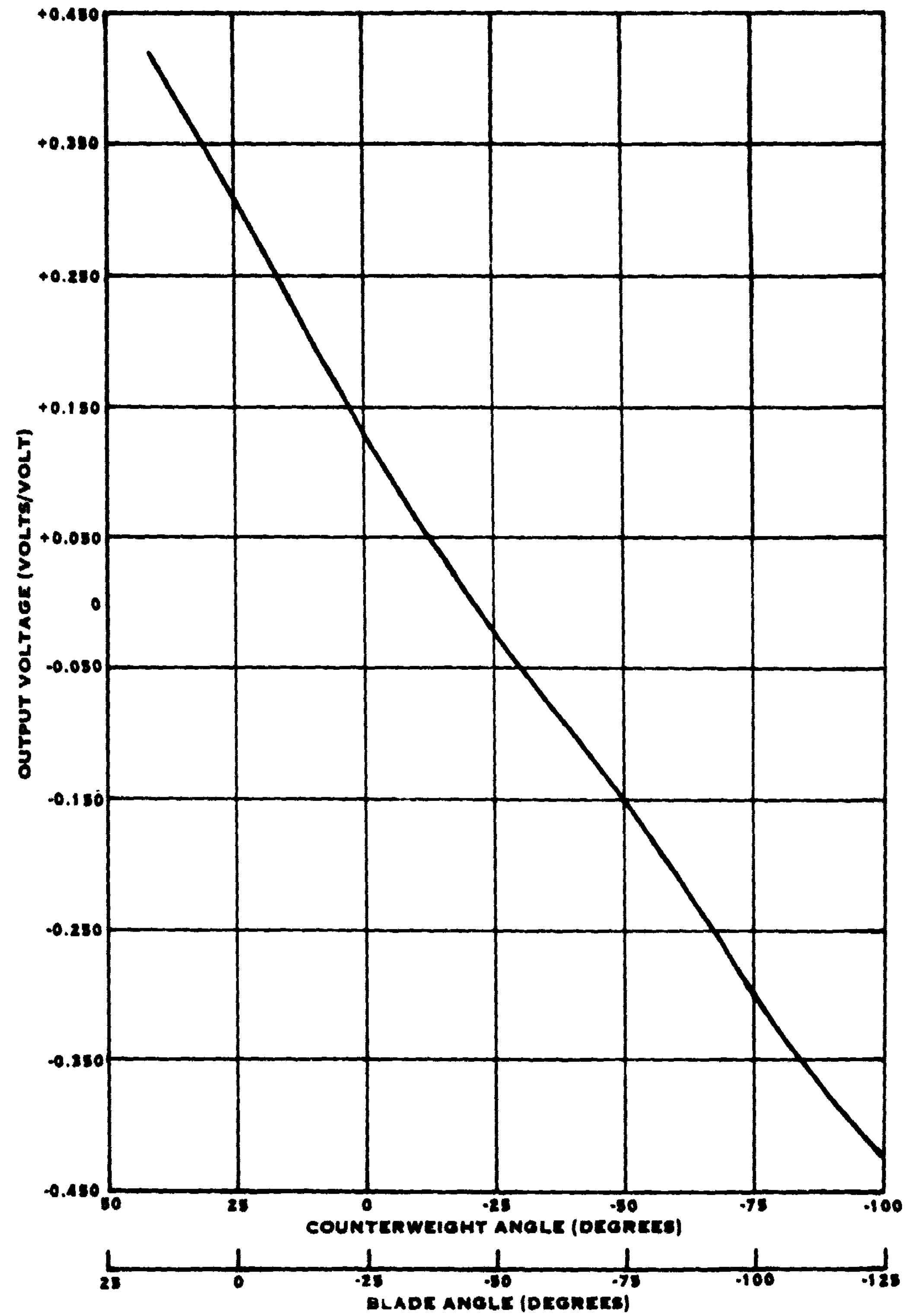

FIGURE 12. OUTPUT VOLTAGE VS. BLADE ANGLE LVDT #1 11-10-75
DATA TAKEN FROM CLOSE TO OPEN

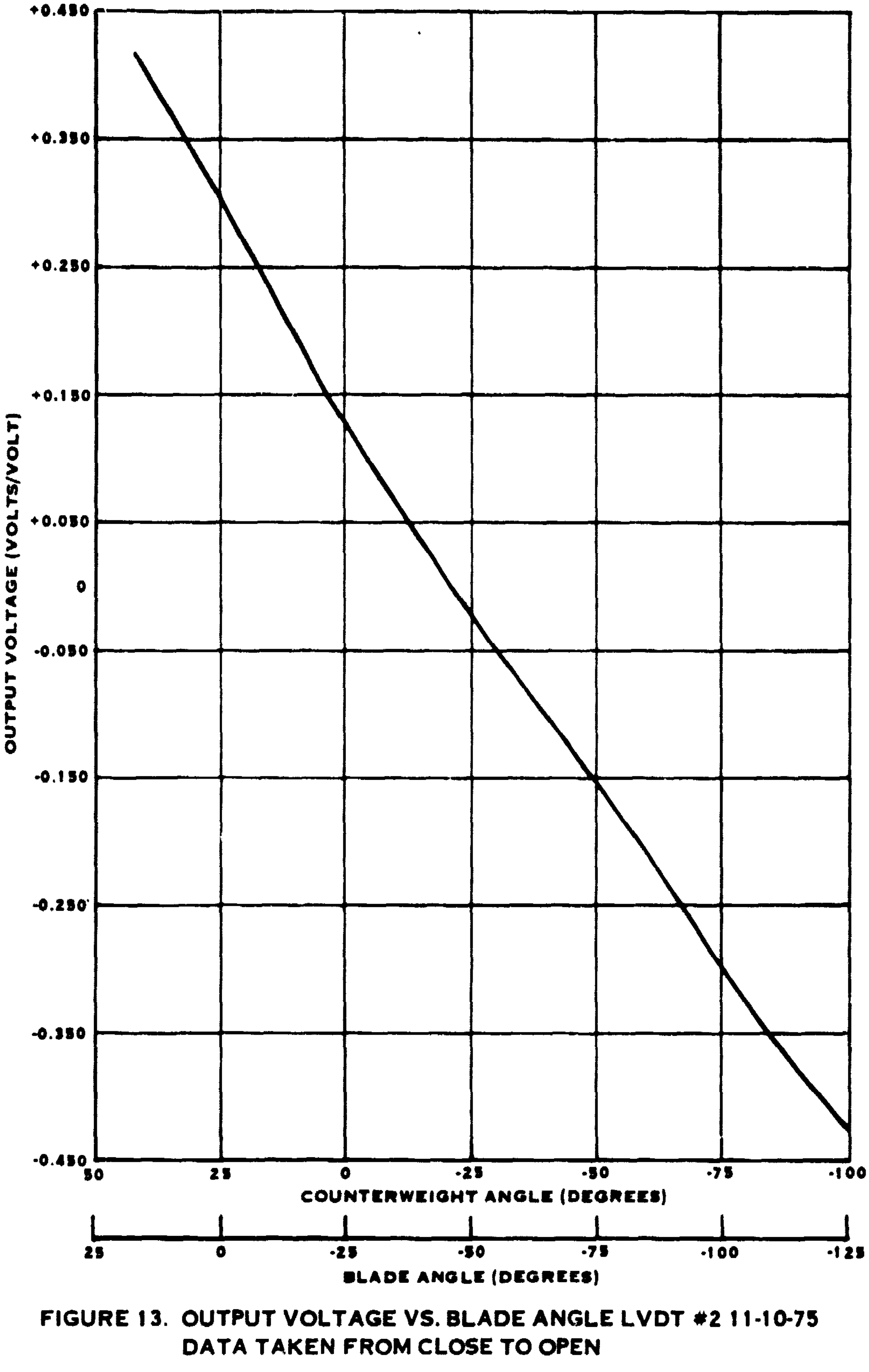

FIGURE 13. OUTPUT VOLTAGE VS. BLADE ANGLE LVDT #2 11-10-75
DATA TAKEN FROM CLOSE TO OPEN

6.0 (Continued)

The data available from the travel limit switch tests indicates that the blade overtravel after a switch actuation at maximum pitch change rate was within the calculated value (6.5°-7.0°), when the data is adjusted for the higher pitch change rate and the effect of the motor back pressure is taken into account.

Table IV is a summary of the data taken during the tests. The data shows that the overtravel and the flex shaft torque are greater at the open end of travel than at the close end. The reason for this has not been determined. Overtravel and flex shaft torque are a function of the pitch change rate, the servo valve time constant, and the drag torque of the torque limiter brake. The higher the pitch change rate, the greater the overtravel and the higher the shaft torque. The greater the valve time constant, the greater the overtravel and the lower the shaft torque. The higher the drag of the torque limiter, the less the overtravel and the lower the shaft torque. Figure 14 is a curve of calculated overtravels and torques versus valve time constants.

In setting the torque limiter brake drag, variations amounting to 1 n-m (10 in. lb) of flex shaft torque from one direction to the other occurs. This does not account for the differences noted in the test. It is felt that the difference is a result of different dynamics in the no-back operation from one direction to the other. Sanborn traces of a travel limit switch stop at both the open and close ends of travel are included in Appendix C.

The rotating blade angle position accuracy test showed a maximum deviation of 1.5° between the set (LVDT) blade angle and the angle determined by the photo diode system. Tables V, VI, and VII are summaries of the data. The deviation noted is within that expected based on estimates of the mechanical and hydraulic hysteresis, the accuracy of the LVDT calibration, and the accuracy of the photo diode system. The three points which show the photo diode sensor angle to be closer to open than the LVDT angle are considered to be bad data points and should be ignored.

The static blade angle position accuracy test showed that the correlation between the set and resultant blade angles were good. In the close direction over a 4° range from 2° open to 2° close the resultant angle deviated from the set angle by a total of 0.25°. This deviation is within the accuracy of the LVDT calibration.

The test also showed that there is slightly less than 1 degree of hysteresis in the system when reversing the direction of blade angle change. This is somewhat greater than the expected value of 0.79 degrees. The expected value consists of a mechanical error of 0.48 degrees, a feedback backlash

TABLE IV
TRAVEL LIMIT SWITCH

DATA FROM 2-13-75

Step Blade Angle Command

Time Constant = 25 milliseconds

Fan Speed = 0 rpm

Blade Angle Travel Prior to Stop - 30 degrees

Actuator with Snubber

Switch Setting Open (degrees)	Switch Setting Close (degrees)	Beta Stop (degrees)	Beta Overtravel (degrees)	Pitch Change Rate (degrees/sec)	Peak Shaft Torque (in-lbs)	Peak Shaft Torque (N-m)
-115.1		-119.0	3.9	101.2	260	29.4
		-120.5	5.4	106.5	300	33.9
		-121.1	6.0	116.2	340	38.4
	+10.2	+12.3	2.1	103.2	230	26.0
		+15.5	5.3	123.8	250	28.2
		+15.6	5.4	123.8	250	28.2

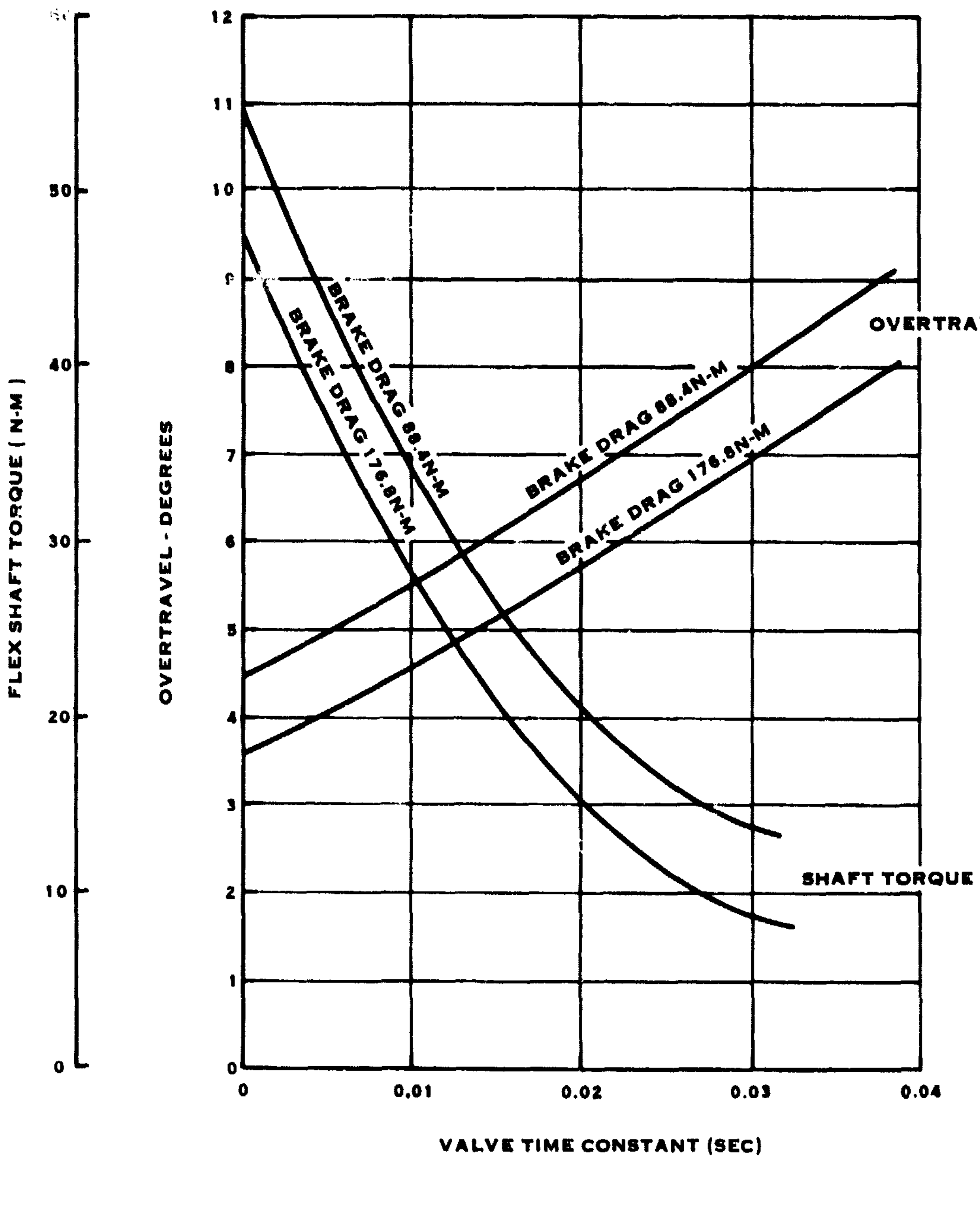

FIGURE 14. CURVE - OVERTRAVEL & SHAFT TORQUE VS VALVE TIME CONSTANT

TABLE V

ANGLE POSITION ACCURACY

(ROTATING)

DATA FROM 12-30-75

	Photo Diode Blade Angle (degrees)	Fan Speed (rpm)
	+ 13.0	2700
	- 2.5	3068
	+ 0.8	3068
	+ 8.0	3068
	+ 4.0	3068
	+ 7.5	3068
	+ 9.5	3068
	+ 7.5	3068
00	-100.5	3068
12.0	+ 13.0	3068

TABLE VI

BLADE ANGLE POSITION ACCURACY

(ROTATING)

DATA FROM 12-30-75

LVDT Blade Angle (degrees)	Photo Diode Blade Angle (degrees)	Fan Speed (rpm)
+12.0	+13.0	2700
- 3.0	- 2.2	2700
0	+ 1.0	2700
+ 7.0	+ 8.5	2700
+ 5.0	+ 6.0	2700
+ 7.0	+ 8.0	2700
+ 9.0	+10.0	2700
+ 7.0	+ 8.0	2700
- 100	-99.5	2700
+12.0	+13.5	2700

TABLE VII

BLADE ANGLE POSITION ACCURACY

(ROTATING)

DATA FROM 12-31-75

LVDT Blade Angle (degrees)	Photo Diode Blade Angle (degrees)	Fan Speed (rpm)
+12.0	+13.0	3068
+ 9.0	+10.5	3068
+ 7.0	+ 8.0	3068
+ 5.0	+ 6.0	3068
0	+ 0.5	3068
- 3.0	- 2.0	3068
- 100	-99.5	3068
- 3.0	- 2.5	3068
0	- 1.0	3068
+ 5.0	+ 5.5	3068
+ 7.0	+ 8.0	3068
+ 9.0	+10.0	3068
+12.0	+13.0	3068

6.0 (Continued)

of 0.07 degrees, a backlash of the trunnion roller to the cam track of 0.14 degrees, and a calibration inaccuracy of 0.10 degrees. The reason for the difference between the measured and expected value is not known, but could be the result of larger than designed mechanical errors or backlash.

Figure 15 is a sketch of the test setup, Table VIII is a summary of the data taken during the test, and Figure 16 is a plot of the data. It should be noted that this is the maximum hysteresis and would only occur at full reverse during normal operation. During forward thrust operation, the actuator is always loaded towards close.

The results of testing to determine the pressure required to start and sustain blade motion are listed in Table IX. In those cases where more than one set of data is given for an excursion, the blades moved a few degrees, stopped, and then moved again as pressure was raised. The data given as "To Sustain" should have been taken when the blades were moving at a constant rate. As most of the excursions were very short, this was not the case. Even in the excursions to and from reverse, the motor flow could not be restricted enough for a constant pitch change rate to be established. The data given for sustaining was taken at a point where the pressure was constant, or almost constant, for a short period of time. The pressures required to start and sustain motion was well within the 3000 psi available for all cases tested. Sanborn traces of this test are included in Appendix C.

Actuator efficiency was determined at the input to the differential gear train where the actual torque on the ground sun gear was measured. Efficiencies were calculated based on data obtained during transient operation of the pitch change actuator. Since these were not steady state pitch change rates, the possibility of errors in the absolute numbers are greater and the results should therefore be used in a manner which reflects this possibility. The efficiencies determined were higher than anticipated, and were in the 70% range. The following tabulation summaries the measured efficiencies.

Blade Angle (deg)	Direction of Motion	Fan Speed (rpm)	Efficiency (%)
-110	Open	3000	76
-100	Close	3000	73
- 66	Close	2500	71
- 50	Close	2350	75
+ 10	Open	2500	73

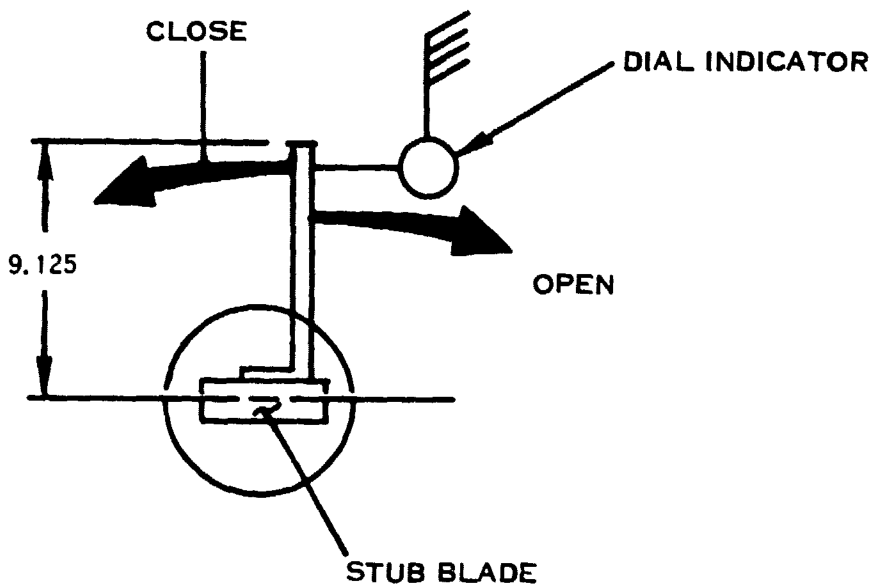

FIGURE 15. TEST SETUP BLADE ANGLE POSITIONING ACCURACY (STATIC)

TABLE VIII

BLADE ANGLE POSITION ACCURACY

STATIC

DATA FROM 2-14-76

BASED ON LVDT #1 CALIBRATION 2-5-76

LVDT Reading (volts)	Set Blade Angle (degrees)	Dial Indicator Reading (inches)	Δ Dial Indicator Reading (inches)	Δ Blade Angle (degrees)	Resultant Blade Angle (degrees)
1.670	-2.000	0.758	0	0	-2.000
1.678	-1.787	0.730	0.028	0.176	-1.824
1.686	-1.574	0.690	0.040	0.250	-1.574
1.693	-1.387	0.666	0.024	0.151	-1.423
1.700	-1.200	0.638	0.028	0.176	-1.247
1.708	-0.987	0.612	0.026	0.163	-1.084
1.715	-0.800	0.582	0.030	0.188	-0.896
1.723	-0.587	0.548	0.034	0.213	-0.683
1.730	-0.400	0.522	0.026	0.163	-0.520
1.738	-0.187	0.486	0.036	0.226	-0.294
1.745	0	0.461	0.025	0.157	-0.137
1.753	+0.213	0.426	0.035	0.220	+0.083
1.760	+0.400	0.400	0.026	0.163	+0.246
1.768	+0.613	0.369	0.031	0.195	+0.441
1.776	+0.826	0.335	0.034	0.213	+0.654
1.784	+1.039	0.306	0.029	0.182	+0.836
1.791	+1.226	0.280	0.026	0.163	+0.999
1.798	+1.413	0.253	0.027	0.170	+1.169

TABLE VIII (Continued)

LVDT Reading (volts)	Set Blade Angle (degrees)	Dial Indicator Reading (inches)	Δ Dial Indicator Reading (inches)	Δ Blade Angle (degrees)	Resultant Blade Angle (degrees)
1.805	+1.600	0.225	0.028	0.176	+1.345
1.813	+1.813	0.189	0.036	0.226	+1.571
1.820	+2.000	0.160	0.029	0.182	+1.753
1.813	+1.813	0.160	0	0	+1.753
1.805	+1.600	0.160	0	0	+1.753
1.798	+1.413	0.160	0	0	+1.753
1.791	+1.226	0.160	0	0	+1.753
1.784	+1.039	0.158	0.002	0.013	+1.740
1.776	+0.826	0.183	0.025	0.157	+1.583
1.768	+0.613	0.213	0.030	0.188	+1.395
1.760	+0.400	0.245	0.032	0.201	+1.194
1.753	+0.213	0.276	0.031	0.195	+0.999
1.745	0	0.306	0.030	0.188	+0.811
1.738	-0.187	0.332	0.026	0.163	+0.648
1.730	-0.400	0.365	0.033	0.207	+0.441
1.723	-0.587	0.390	0.025	0.157	+0.284
1.715	-0.800	0.426	0.036	0.226	+0.058
1.708	-0.987	0.457	0.031	0.195	-0.137
1.700	-1.200	0.488	0.031	0.195	-0.332
1.693	-1.387	0.515	0.027	0.170	-0.502
1.686	-1.574	0.540	0.025	0.157	-0.659
1.678	-1.787	0.573	0.033	0.207	-0.866
1.670	-2.000	0.606	0.033	0.207	-1.073

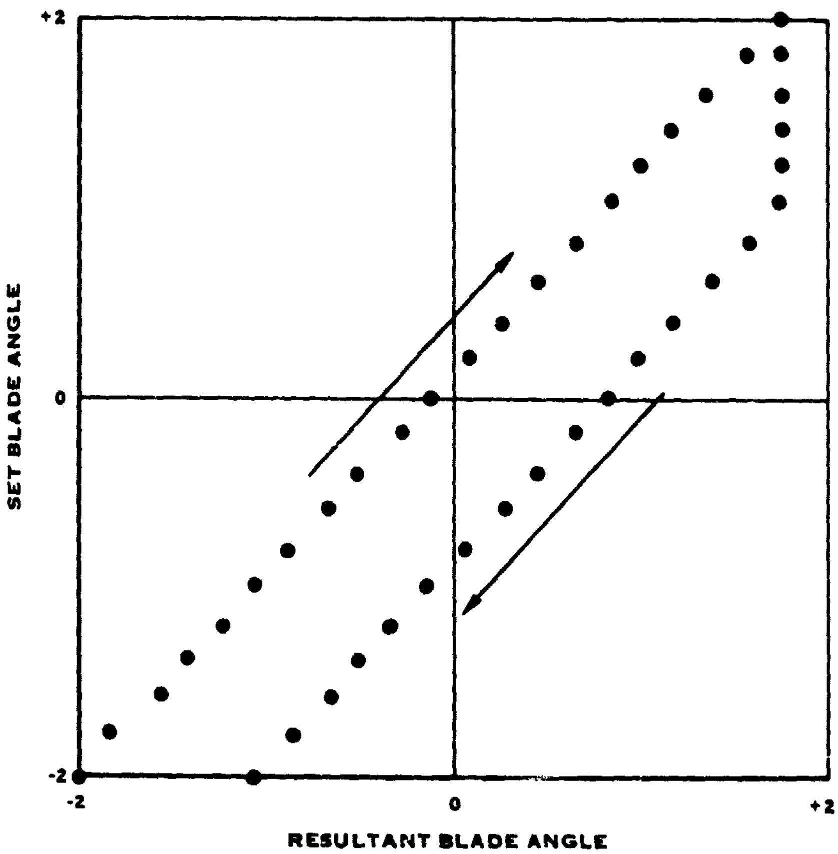

FIGURE 16. BLADE ANGLE POSITION ACCURACY DATA FROM 2-14-76
SET BLADE ANGLE VS. RESULTANT BLADE ANGLE

TABLE IX. PERFORMANCE

Data from 12-31-75

Blade Angle Excursion (degrees)	Fan Speed (rpm)	Pressure to Start Motion (psig)	Pressure to Start Motion (newtons/ cm^2)	Pressure to Sustain Motion (psig)	Pressure to Sustain Motion (newtons/ cm^2)	Torque to Start Motion (in-lb)	Torque to Start Motion (newton meter)	Torque to Sustain Motion (in lb)	Torque to Sustain Motion (newton meter)	Pitch Change Rate (max) (degrees/ sec)
+12 to -3	2700	950	655.0	1000	689.4	22	2.5	34	3.8	3.75
(+10.5)	2700	1100	758.4	1100	758.4	26	2.9	40	4.5	22.5
-3 to 0	3408	400	275.8	250	172.4	4	0.5	6	0.7	11.25
0 to +7	3068	450	310.2	250	172.4	4	0.5	10	1.1	18.75
+7 to +5	3068	1600	1103.1	1000	689.4	50	5.6	42	4.7	7.5
+5 to +7	3068	400	275.8	200	137.9	4	0.5	4	0.5	3.75
+7 to +9	3068	300	206.8	200	137.9	4	0.5	6	0.7	11.25
+9 to +7	3068	1000	689.4	1000	689.4	50	5.6	40	4.5	5.25
	3068	1500	1034.2	1200	827.3	76	8.6	60	6.8	11.25
+7 to -100	3068	1600	1103.1	400	275.8	50	5.6	4	0.5	75.0
-100 to +7	2700	1000	689.4	1000	689.4	18	2.0	34	3.8	22.5
	2700	1600	1103.1	1000	689.4	42	4.7	20	2.3	67.5

6.0 (Continued)

The average pitch change rate for a blade angle excursion from -3 degrees to -100 degrees at 3315 fan rpm with a EHV supply pressure of 2378.6 ± 34.4 newtons per square centimeter (3450 + 50 psig) was 116 degrees per second. The maximum rate attained was 135 degrees per second. A Sanborn trace of this test is included in Appendix C. The design objective was 135 degrees per second maximum.

The minimum blade angle change which could be achieved around 0 degrees with a fan speed of 3408 rpm and a EHV supply pressure of 2378.6 ± 34.4 newtons per square centimeter (3450 + 50 psig) was 0.17 degrees in the open direction and 0.26 degrees in the close direction based on LVDT motion. The design objective was 0.5 degrees.

With the blade angle set at -100 degrees, EHV supply pressure at 0, and the fan speed increased from 0 to 3578 rpm, no blade angle change occurred based on LVDT readout indicating that the no back mechanism did not slip.

With the blade angle set at 0 degrees, EHV supply pressure at 0, and fan speed increased from 0 to 3408 rpm, no blade angle change occurred based on LVDT readout indicating that the no back mechanism did not slip.

The results of the frequency response testing are presented in Figures 17 through 22. The data in Figures 17 through 20 is for the actuator without a snubber while the data in Figures 21 and 22 is for the actuator with a snubber. In general, the actuator without the snubber indicated reasonable correlation with the predicted performance in the frequency range up to 1 Hertz; magnitude ratio was lower and phase shift was higher than at frequencies above 1 Hertz. The actuator with the snubber indicated reasonable correlation in the frequency range up to 1 Hertz when excitation magnitudes were ± 8 ma. However for ±4 ma excitation the magnitude ratio was down and there was considerable phase shift.

Possible causes of the deviation between the test results and the design intent are high internal leakage in the hydraulic motors, higher than anticipated friction values, and lags due to the snubber.

A total of 500 endurance cycles at pitch change rates up to 75 degrees/second, were conducted on the actuator prior to installation of the snubber, and an additional 50 cycles at pitch change rates up to 135 degrees/second after snubber installation. Sanborn traces of a typical cycle are included in Appendix C.

Copies of the log sheets generated during the test are included in Appendix D, and a test chronology is included in Appendix E.

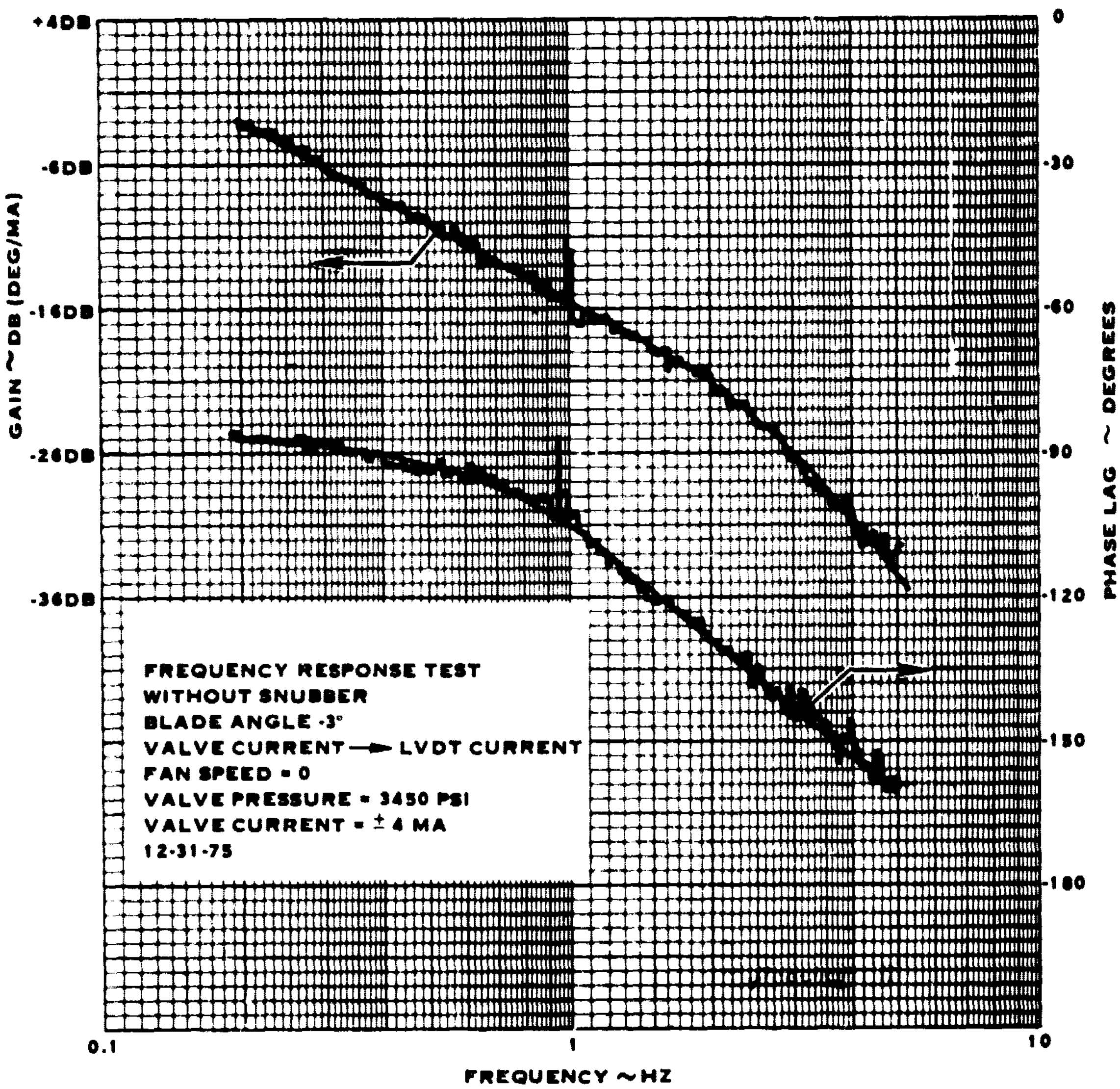

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FIGURE 17. QCSEE FREQUENCY RESPONSE

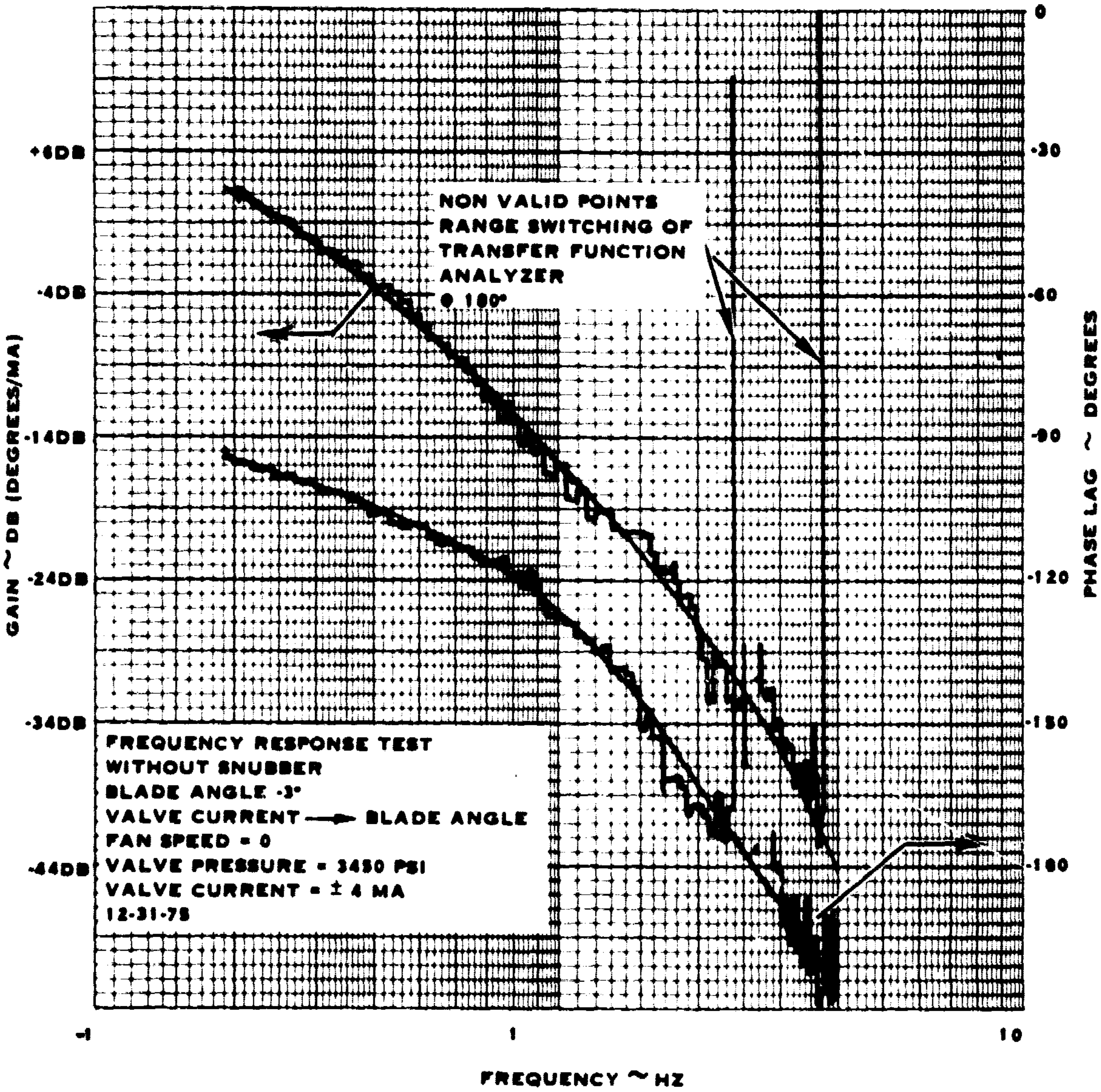

FIGURE 18. QCSEE FREQUENCY RESPONSE

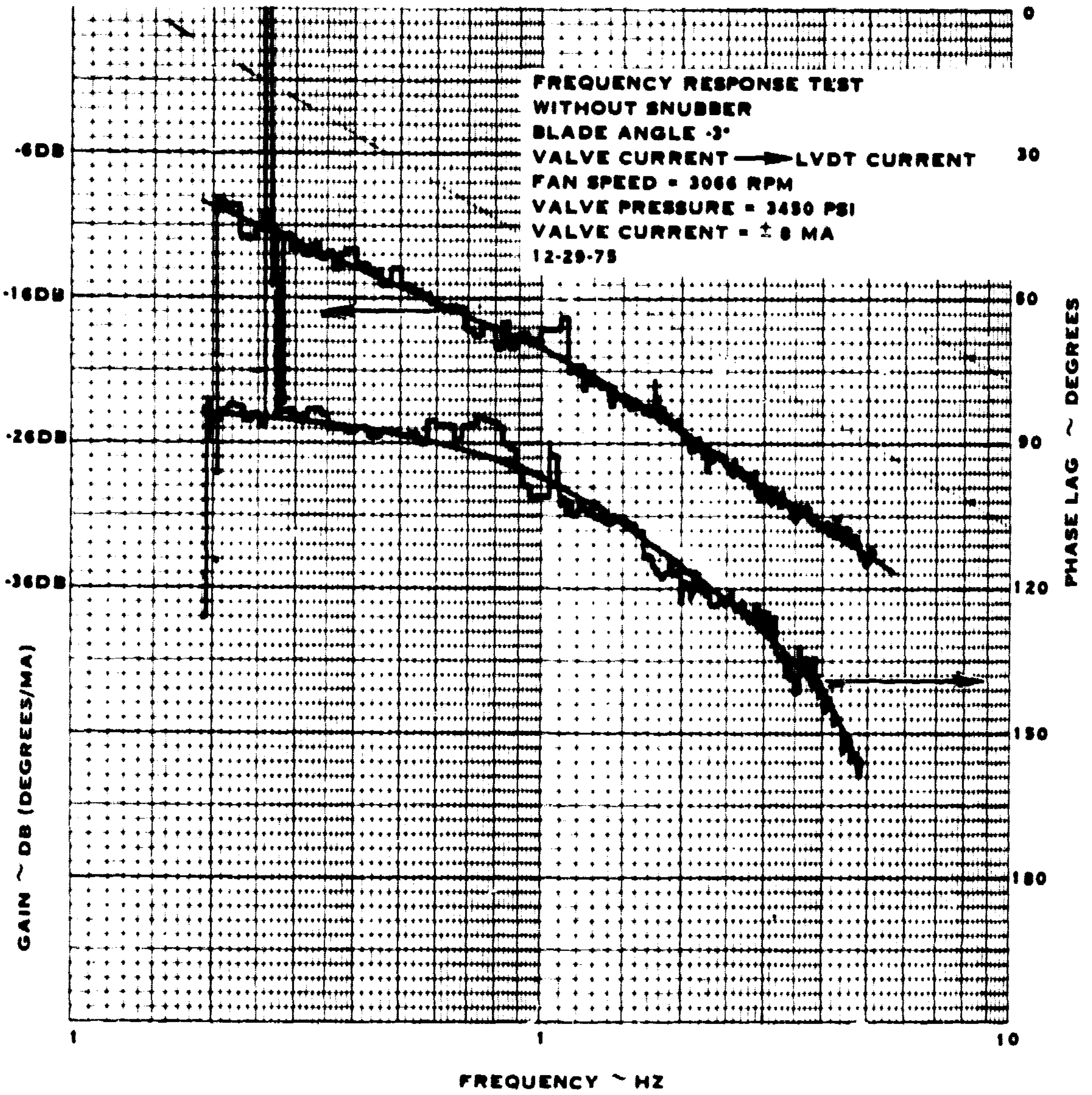

FIGURE 19. QCSEE FREQUENCY RESPONSE

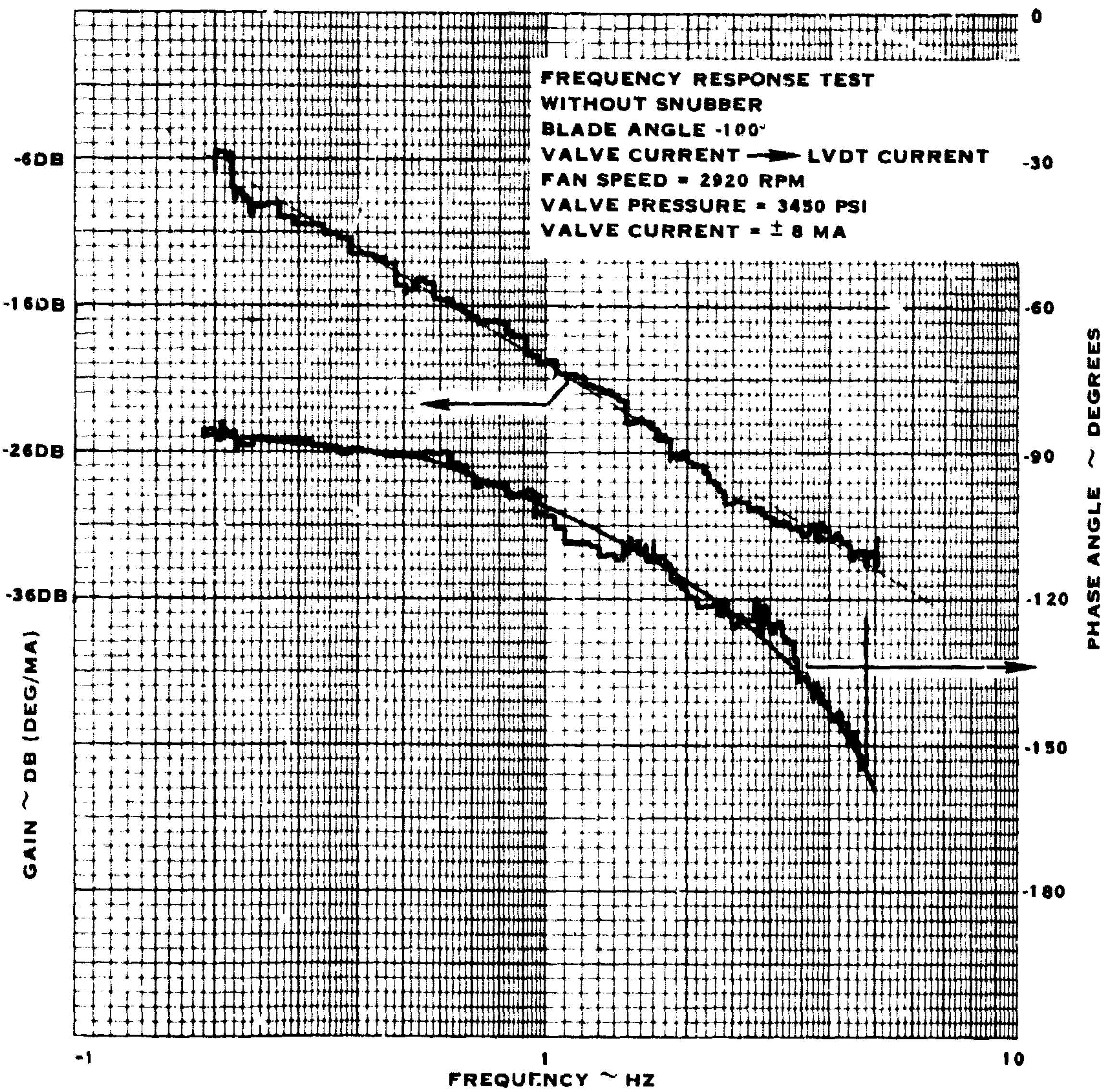

FIGURE 20. QCSEE FREQUENCY RESPONSE

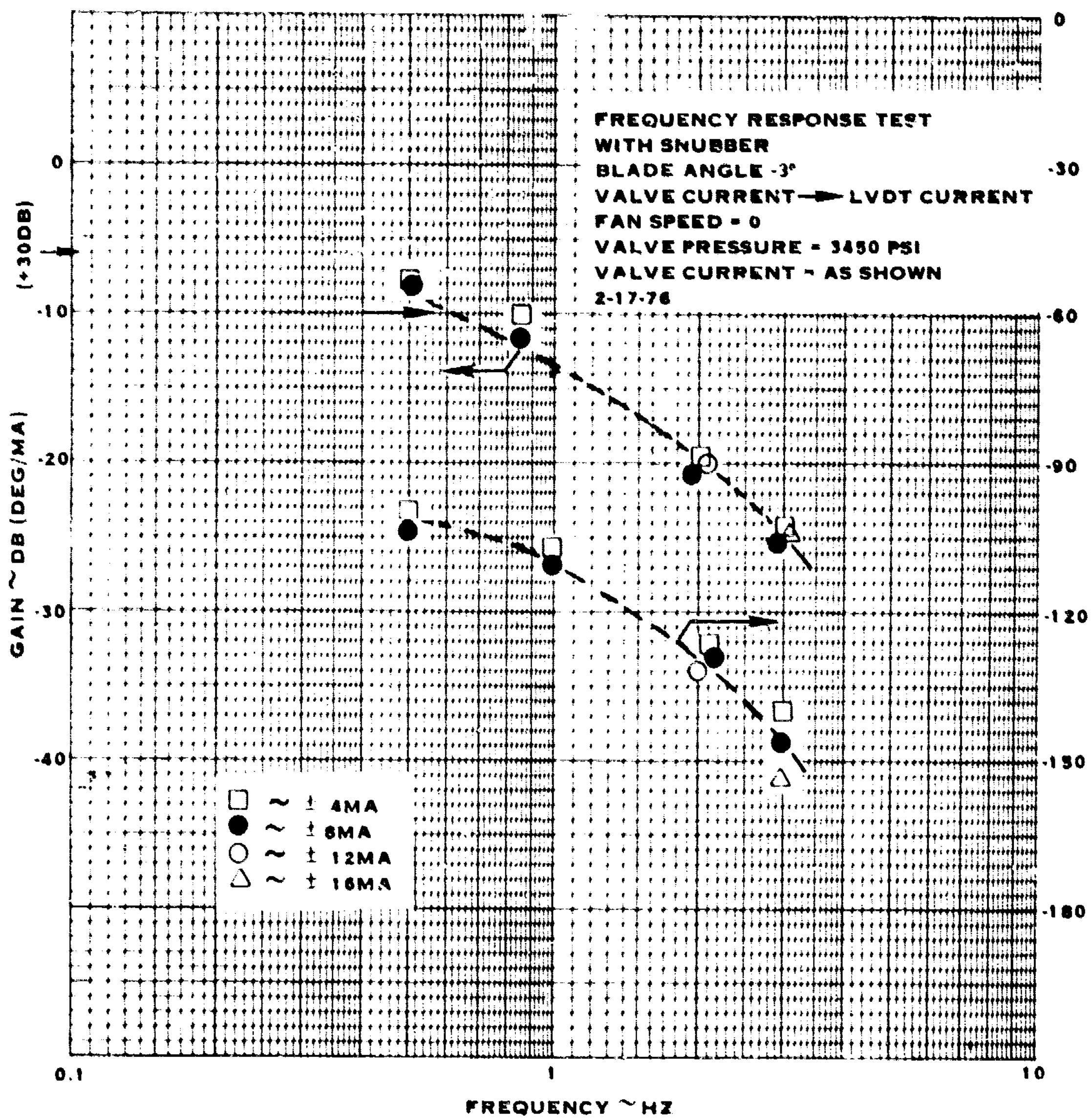

FIGURE 21. QCSEE FREQUENCY RESPONSE

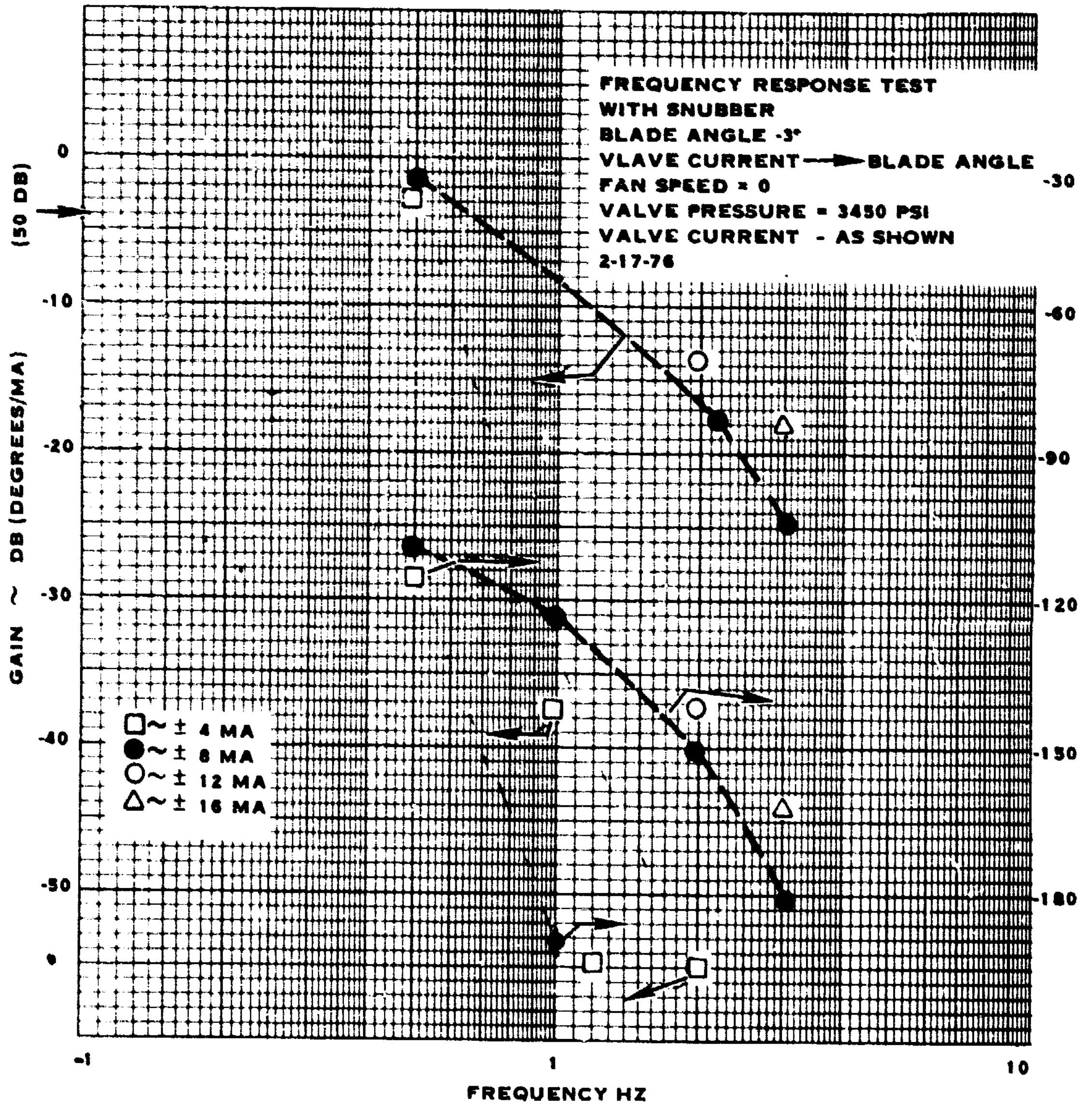

FIGURE 22. QCSEE FREQUENCY RESPONSE

7.0 CONCLUSION

The results of the whirl rig testing shows that the pitch change actuator system, incorporating the snubber, satisfies the design requirements and is structurally adequate for use on the QCSEE being developed for NASA.

The pitch change actuator system was subsequently shipped to General Electric for installation in the engine.

8.0 APPENDICES

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APPENDIX A

OPERATING PROCEDURE

222PT-37

OPERATING PROCEDURE

FOR

QCSEE ACTUATOR

WHIRL RIG

November 5, 1975

Prepared by: [signature]

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CONTENTS

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1.0 GENERAL

The purpose of this document is to define a procedure for operating the QCSEE pitch change actuator on the Hamilton Standard whirl test rig (G-7 in the Hydraulics Lab). Copies of this operating procedure will be distributed as follows:

Test Rig - 2 copies
Facilities Group - 1 copy
Engineering - 6 copies (Project and Design)
Lab Supervision - 2 copies
Instrumentation - 2 copies

This document takes precedence over test plans as far as rig operating procedure is concerned. The Test Director will resolve all conflicts.

2.0 RESPONSIBILITIES

All persons associated with the QCSEE actuator test program will be required to conform to the operating principles defined in this document. The actual conduct of the test, in accordance with an approved test plan, will be under the control of a Test Director appointed from the Propeller Project Group. Conduct of the test will be the responsibility of this Test Director or his designated representative.

3.0 RIG OPERATION

3.1 General - The rig will be operated, at all times, in accordance with these instructions.

3.2 Test Item - The actuator assembly is defined by drawings 763499 (Beta Regulator) and 763500 (Actuator). Installation and removal of this hardware will be accomplished in accordance with HS 6971 - "Assembly and Test of QCSEE Actuator".

3.3 Pre-Run Inspection - Immediately prior to starting the rig, an inspection must be performed and a "Pre-Run Check List" filled out and signed by both the Rig Operator and the cognizant Engineer conducting the test. A new check list must be filled out if any work is done on instrumentation, rig or test item.

3.4 Rig Start-Up

3.4.1 Check to insure that the following has been accomplished:

a) Gear box lube system on.
b) Clutch water on.
c) Actuator control system on.
d) Rig speed control set for "manual".
e) Drive motor on.

Energize clutch control and bring speed up to 500 rpm. If operation is satisfactory, increase speed to 2000 rpm and record a set of data per paragraph 6.0 before proceeding to test plan.

3.5 Rig Shutdown - Normal rig shutdown will be accomplished, with the rig speed control set at the manual position, by reducing rig speed setting to zero and turning off the clutch and drive motor.

3.6 Emergency Shutdown - If an incident or change in readings occur which the Engineer or Operator judge requires an emergency shutdown, the following procedure will be followed:

a) Turn drive motor power off.
b) After disc coasts down, turn off gear box lube, actuator lube and actuator hydraulic system.
c) Immediately write down all observations noted at the time the incident occurred and mark Sanborn record with time and character of incident.

3.7 After Operation Inspection - Immediately following rig shutdown, when it is intended that some changes will be made on the test item, or when the rig will be down for more than 30 minutes, a "Post Run Check List" must be filled out by the Engineer and the Operator.

3.8 Operating Limits - The following are the operating limits which should not be exceeded at any time during operation of this rig:

Fan Speed	3600 rpm max.
EHV Supply Pressure	3800 psi max.
EHV Supply Temperature	250°F max.
Beta Regulator Speed	22,000 rpm max.
Lube Oil Flow	.8 - 1.0 qts/min.
Lube Oil Temperature (Actuator)	250°F max.
Cell Temperature	150°F max.
Vibration	2 mils max.
Clutch Water Temp.	180°F max.
Shaft Torque	125 in-lbs. max.

4.0 INSPECTION OF HARDWARE

Hardware inspection intervals will be established by the Test Director based on results obtained during the test program.

5.0 RIG INSTRUMENTATION

Instrumentation will be provided on the rig to obtain the data defined in Table I. All measurements noted as recording will be continuously recorded at a paper speed of .1 in/sec.

6.0 LOG SHEETS

A log sheet shall be maintained for all running of the actuator or its components on this rig.

6.1 Frequency - Entries shall be made on this log sheet in accordance with the following schedule:

a) For each start.
b) Each new functional test condition being evaluated or at 15 minute intervals.
c) For the first endurance cycle of the run and for every fifth endurance cycle thereafter. Readings to be taken at the start and completion of each cycle.
d) Prior to shutdown.
e) As requested by Test Director.

6.2 Content - The log sheets will include the following information:

a)* Date and time of entry.
b) Name of test - G.E. QCSEE Actuator - Functional (or Endurance) Test.
c) Rig Speed
d) Blade Angle (from control readout)
e)* Lube oil flow
f)* Lube oil temperature
g)* Lube oil pressure
h)* EHV Supply Pressure
I)* EHV Supply Temperature
j) Cell temperature
k)* Vibration - horizontal and vertical
l) Clutch temperature
m) G.B. oil pressure
n) Test plan paragraph
o)* Cycle number
p) Operator and Engineer's name

* Record only these for 6.1(c).

6.3 Recorded Data - Data noted as recording on Table I will be recorded continuously at a record speed of 0.1 in/sec. unless a faster speed is required for the particular test being conducted. All records will be suitably marked with test plan paragraph number or cycle number and date and time for identification and to permit correlation with the rig log sheets.

TABLE 1

Measurement	Range	Type
EHV Supply Pressure	0-4000 psig	Visual
EHV Current Signal	±100 ma	Recording
Flow to EHV	0-45 gal/min	Recording
Δ P Across Motor (1)	0-3500 psig	Recording
Fluid Temperature	0-300°F	Visual
Blade Angle Command	+20° to -120°	Visual and Recording
LVDT Feedback Voltage (1)	±5 V dc	Recording
Flex Shaft Speed	0-24,000 rpm	Recording
Flex Shaft Torque	0-200 in.lb.	Recording
Lube Oil Flow	0-1 qt/min.	Visual
Lube Oil Pressure	0-100 psig	Visual
Lube Oil Temperature	0-300°F	Visual
Fan Speed	0-3700 rpm	Visual and Recording
Cell Temperature	0-300°F	Visual
Vibration - Horizontal		Visual
Vibration - Vertical		Visual
Fan Blade Angle	+20° to -120°	Visual

HSER 7002
11/4/75

POST RUN CHECK LIST

QCSEE ACTUATOR - G-7 RIG

Date:____________________
Rig Time:__________________
Flight Cycles:______________

	Item	Condition	Initial	
			Operator	Engineer
1	All hardware appears structurally sound.			
2	No evidence of oil leakage.			
3	Arm, disc and cam area clean, dry and free of foreign objects.			
4	All visible bolts, nuts, mounts, etc. appear secure.			
5	All pumps shut off.			
6	Disc and actuator covered up if unit will be shut down for any period of time and is not being worked on.			
7	All data recorded and records properly marked.			

REMARKS -

HSER 7002
11/4/75

PRE RUN CHECK LIST

QCSEE ACTUATOR - G-7 RIG

Date:________________
Rig Time:_______________
Flight Cycles:___________

	Item	Condition	Initial	
			Operator	Engineer
1	Disc uncovered.			
2	Instrumentation connected and operating.			
3	Arm, disc and cam area clean, dry and free of foreign objects.			
4	All visible bolts, nuts, mounts, etc. appear secure.			
5	Stop switches correctly set and Beta Regulator indexed to actuator (feedback and actual blade angle agree).			
6	Hydraulic pumps on, bypass closed and correct pressure at servo valve (per test plan).			
7	Actuator lube pump on and set for ______ psi at Beta Regulator.			
8	All personnel and loose material out of cell and cell doors secured.			

REMARKS -

APPENDIX B

TEST PLANS

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION

WINDSOR LOCKS, CONNECTICUT • U.S.A.

No. 222PT-31 Rev. A

DATE: 10/28/75

PLAN OF TEST

ITEM: 763500 Actuator (QCSEE)

PREPARED BY: D. Leishman

CONTRACT: GE 200-4XX-14G-38570

APPROVED BY: D. Z. [illegible]

TEST PERIOD:

1. WHAT IS ITEM BEING TESTED?
2. WHY IS TEST BEING RUN? WHAT WILL RESULTS SHOW OR BE USED FOR?
3. DESCRIBE TEST SETUP INCLUDING INSTRUMENTATION. ATTACH SKETCH OF INSTALLATION.
4. ITEMIZE RUNS TO BE MADE GIVING LENGTH OF EACH AND READINGS TO BE TAKEN.
5. SPECIAL INSTRUCTIONS: SAFETY PRECAUTIONS FOR OPERATORS AND HANDLING EQUIPMENT. OBSERVATIONS BY SIGHT, FEEL, OR HEARING. LIST POINTS OF OBSERVATION WHICH MIGHT CONTRIBUTE TO ANALYSIS OF (A) PERFORMANCE OF UNITS, (B) INCIPIENT TROUBLE BEFORE IT OCCURS, AND (C) CAUSE OF FAILURE.
6. HOW WILL DATA BE USED OR FINALLY PRESENTED? GIVE SAMPLE PLOT, CURVE, OR TABULATION AS IT WILL BE FINALLY PRESENTED.

NUMBER ENTRY AS LISTED ABOVE AND DESCRIBE BELOW

1.0 The item being tested is the pitch change actuator for the QCSEE assembled for reverse through stall operation.

2.0 The test is being run to determine the operating characteristics of the actuator, verify that it satisfies the design requirements, and assure its structural adequacy for use in an engine test.

3.0 The actuator, together with a disc and stub blades supplied by GE will be mounted in G-7 Whirl Rig which has been modified to accept the unit. Reference Figure 1. A closed loop variable gain control system with a capabality to vary gain between 570 and 2700 ma/volt/volt excitation will be utilized for the test. The instrumentation to be used during the test is listed in Table 1. Figure 2 is a drawing showing the hardware necessary to convert the actuator to a front flex shaft input, and Figure 3 is a lubrication schematic of the actuator.

4.0 The following tests will be conducted. All blade angles are in GE terms. Figure 4 is a plot of blade angle vs. counterweight angle.

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TABLE 1

Measurement	Range	Type
EHV Supply Pressure	0-4000 psig	Visual
EHV Current Signal	±100 ma	Recording
Flow to EHV	0-45 gal/min	Recording
ΔP Across Motor (1)	0-3500 psig	Recording
Fluid Temperature	0-300°F	Visual
Blade Angle Command	+20° to -120°	Visual and Recording
LVDT Feedback Voltage (1)	±5 V dc	Recording
Flex Shaft Speed	0-24,000 rpm	Recording
Flex Shaft Torque	0-200 in.lb.	Recording
Lube Oil Flow	0-1 qt/min.	Visual
Lube Oil Pressure	0-100 psig	Visual
Lube Oil Temperature	0-300°F	Visual
Fan Speed	0-3700 rpm	Visual and Recording
Cell Temperature	0-300°F	Visual
Vibration - Horizontal		Visual
Vibration - Vertical		Visual
Fan Blade Angle	+20° to -120°	Visual

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4.1 Lubrication Flow Check

4.1.1 With the flex drive shaft disconnected from the actuator, determine the pressure setting necessary at the beta regulator to obtain a flow of .85 qts/min through the shaft at a shaft speed of 0 rpm.

4.2 LVDT Null & Calibration (fan speed = 0 rpm)

4.2.1 Using the manual input to the Beta Regulator, determine the LVDT output and blade angle at the mechanical stops of the actuator. Reset the LVDT null so that the output varies an equal amount on either side of null as the blade moves through the full range of travel.

4.2.2 Using the manual input to the Beta Regulator, calibrate actual blade angle versus LVDT output voltage every 5° over the full range of travel in both increasing and decreasing pitch directions. During this calibration, set the travel limit switch cams to actuate at -8° and -96° blade angle.

4.3 Travel Limit Switch

4.3.1 With the travel limit switch cams set for -8° and -96°, and a fan speed of 0 rpm, determine the actual blade angle at which the blades stop when the travel limiting switch is actuated at flex shaft speeds of approximately 6000 rpm, 12,000 rpm and 21,000 rpm. Regulate EHV supply pressure to control rate.

4.3.2 With the travel limit switch cams set for -8° and -96°, and a fan speed of 2500 rpm, determine the actual blade angle at which the blades stop when the travel limit switch is actuated at flex shaft speeds of approximately 6000 rpm, 12,000 rpm and 21,000 rpm.

4.3.3 Reset the travel limit switch cams for +12.5° and -116° or to a modified value if testing does not confirm the calculated values of travel required to stop the system (6.5 -7°).

4.4 Blade Angle Position Accuracy

4.4.1 With the EHV inlet pressure set at 2000 $\pm$100 psig and a fan speed of 2500 rpm, cycle the actuator in accordance with Table 2. At each condition, record actual vs. LVDT blade angle.

Table 2

Step (Reference Table 5)	Blade Angle
1	+12°
3	-3°
5	0°
6	+7°
7	+5°
8	+7°
9	+9°
10	+7°
12	-100°
15	+12°

4.4.2 With the EHV inlet pressure set at 3450 $\pm$100 psig, and fan speed as shown, cycle the actuator in accordance with Table 2a. At each condition, record actual vs. LVDT blade angle.

Table 2a

Step (Reference Table 5)	Blade Angle	Fan Speed
1	+12°	2500
3	-3°	3068
5	0°	3068
6	+7°	3068
7	+5°	3068
8	+7°	3068
9	+9°	3068
10	+7°	3068
12	-100°	3068
15	+12°	2500

4.5 Performance

4.5.1 Determine the pressure required to start actuator motion in both increasing and decreasing pitch directions for the conditions specified in Table 3.

Table 3

Fan Speed	Starting Blade Angle
2500 rpm	+12° (increasing only)
3068 rpm	+5°
3068 rpm	+7°
3068 rpm	+9°
3408 rpm	0°
3408 rpm	-3°
2500 rpm	-100° (decreasing only)

4.5.2 Determine the pressure required to sustain actuator motion for the blade angle excursions specified in Table 4.

Table 4

Fan Speed	Blade Angle Excursion
2500 rpm	+12° to -3°
3408 rpm	-3° to +0°
3068 rpm	0° to +7°
3068 rpm	+7° to +5°
3068 rpm	+5° to +7°
3068 rpm	+7° to +9°
3068 rpm	+9° to +7°
3068 rpm	+7° to -100°
2500 rpm	-100° to +12°

4.5.3 Determine the average pitch change rate for a blade angle excursion from -3° to -100° at a fan speed of 3315 rpm. EHV supply pressure to be set at 3450 $\pm$50 psig. (rate based on LVDT feedback voltage)

4.5.4 With the blade angle set at 0°, fan speed of 3408 rpm, and EHV supply pressure 3450 $\pm$50 psig, demonstrate the minimum blade angle change which can be obtained around 0°.

4.5.5 With the blade angle set at -100°, EHV supply pressure at 0 psig, increase fan speed to 3578 rpm and record any blade angle change.

4.5.6 With the blade angle set at 0°, EHV supply pressure at 0 psig, increase fan speed to 3408 rpm and record any blade angle change.

4.6 Frequency Response

4.6.1 At a blade angle of -3° and with a fan speed of 0 rpm, determine B_f/ EHV and LVDT/ EHV. Static frequency response and phase angle shall be determined for EHV current peak to peak amplitudes not to exceed $\pm$40 ma or that current input which causes a B_f variation of $\pm$1.9 to $\pm$2.1 degrees at frequencies of 0.5, 1.0, 1.5, 2.0, 3.0, and 4.0 Hz.

4.6.2 Rotating frequency response tests will be conducted to determine Δ LVDT/ΔEHV.

Two base point conditions will be used:

1. Fan speed = 3066 rpm.
   B_f = 3° open.

2. Fan speed = 2920 rpm.
   B_f = 100° open.

Frequency response and phase angle for base point conditions 1 and 2 shall be determined for EHV current peak to peak amplitudes not to exceed $\pm$40 ma or that current input which causes a LVDT variation of +.0135 to $\pm$.0165 volts/volt at frequencies of 0.5, 1.0, 1.5, 2.0, 3.0, and 4.0 Hz.

4.7 Endurance Test

4.7.1 Prior to and at completion of the endurance test, the unit will be disassembled and the hardware will be examined to identify any potential problem areas.

4.7.2 The endurance test will consist of 500 cycles of the actuator in accordance with Table 5. During testing, the EHV supply pressure will be maintained at 3450 $\pm$50 psig. The cycles may be run faster than the normal anticipated engine duty cycle in order to shorten the required test time. The cycle frequency will be established during the functional test program. The limiting factor will be the ability of the unit to dissipate the heat generated in the no-back and the clutch. The blade angle must be allowed to stabilize at each point prior to going on to the next point except during modulating operation. (Steps 7-11 of Table 5)

5.0 Special Instructions

Prior to and following operation, the check list shown in Figure 5 must be completed. Note any unusual noises or vibrations, or any changes in noise

TABLE 5

1 cycle

Step	Fan Speed	Blade Angle
1	2500 rpm	+12°
2	2500	-3°
3	3408	-3°
4	3408	0°
5	3068	0°
6	3068	+7°
7	3068	+5°
8	3068	+7°
9	3068	+9°
10	3068	+7°
11	Repeat steps 7 thru 10 twenty times	
12	3068	-100°
13	3408	-100°
14	2500	-100°
15	2500	+12°

5.0 Continued

or vibration. During the static and performance testing, a log sheet shall be kept which contains the parameters denoted as visual in Table 1 for each test point. Functional test data denoted as recording shall be taken at each test point at a speed commensurate with the test being run.

During the endurance test, a log sheet shall be kept which contains the parameters denoted as visual in Table 1 for the first and each fifth cycle thereafter. Endurance test data denoted as recording shall be taken continuously at a speed of .1 in/sec.

In order to provide a complete time/rpm history for the fan rotor components, data denoted as recording shall be taken at a speed of .1 in/sec at all times when the fan is rotating except when higher recording speeds are needed for a specific test point.

6.0 A component test report will be prepared following the completion of the whirl rig tests. Discussions and data presented in the report will cover all tests conducted during the whirl rig test program. All test data will be available for review and use by GE and NASA representatives.

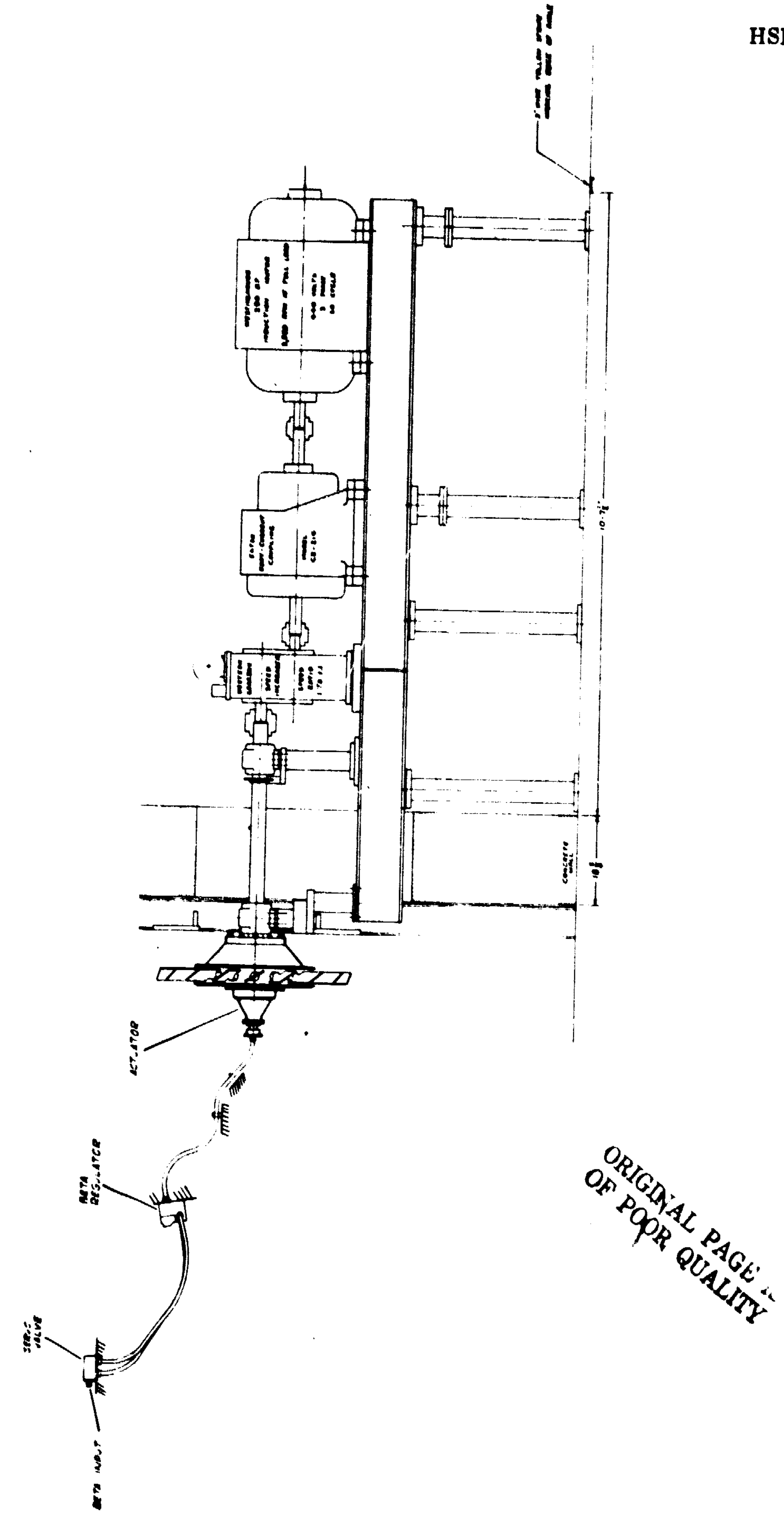

FIGURE 1. WHIRL RIG ARRANGEMENT

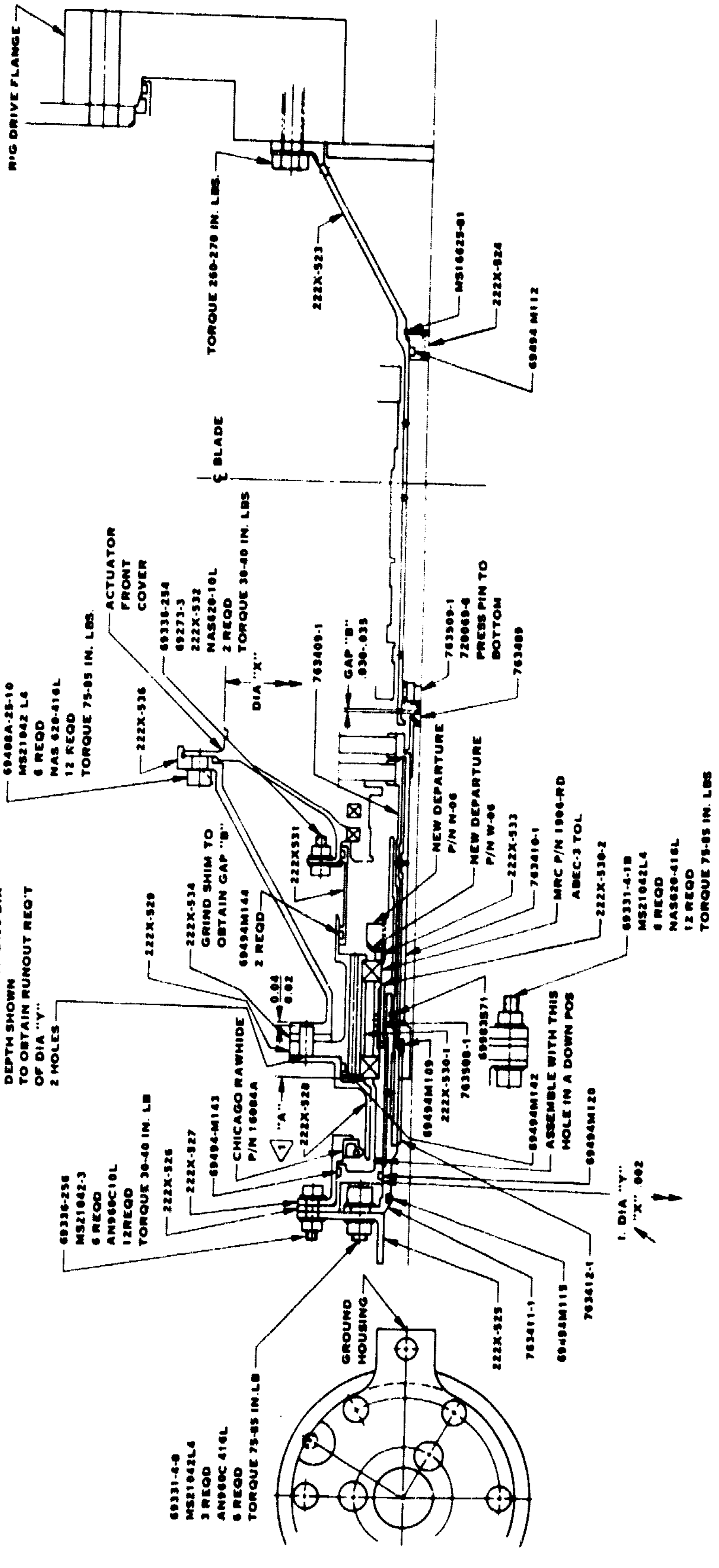

FIGURE 2. ASSEMBLY, FRONT INPUT HARDWARE

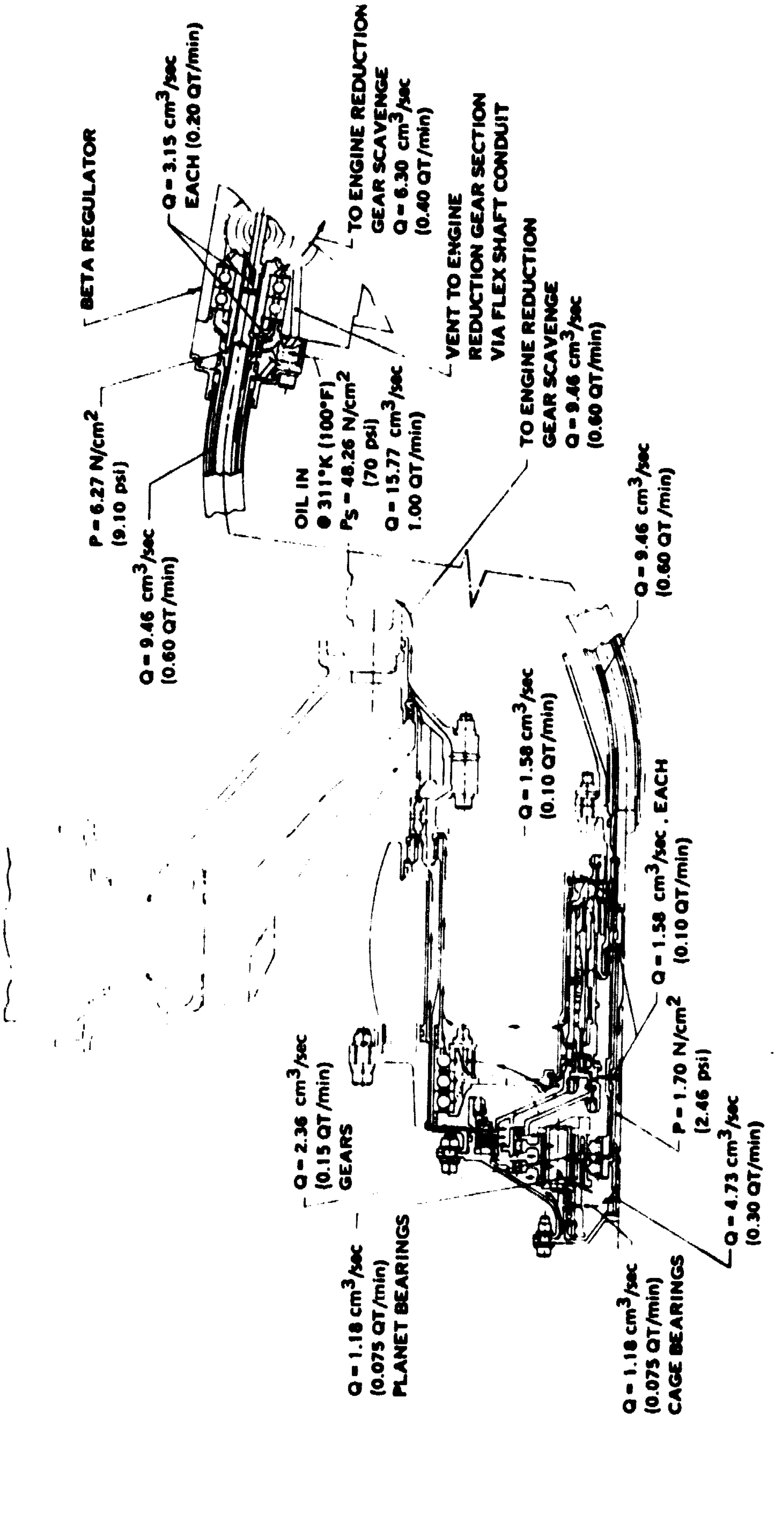

FIGURE 3. LUBRICATION SCHEMATIC

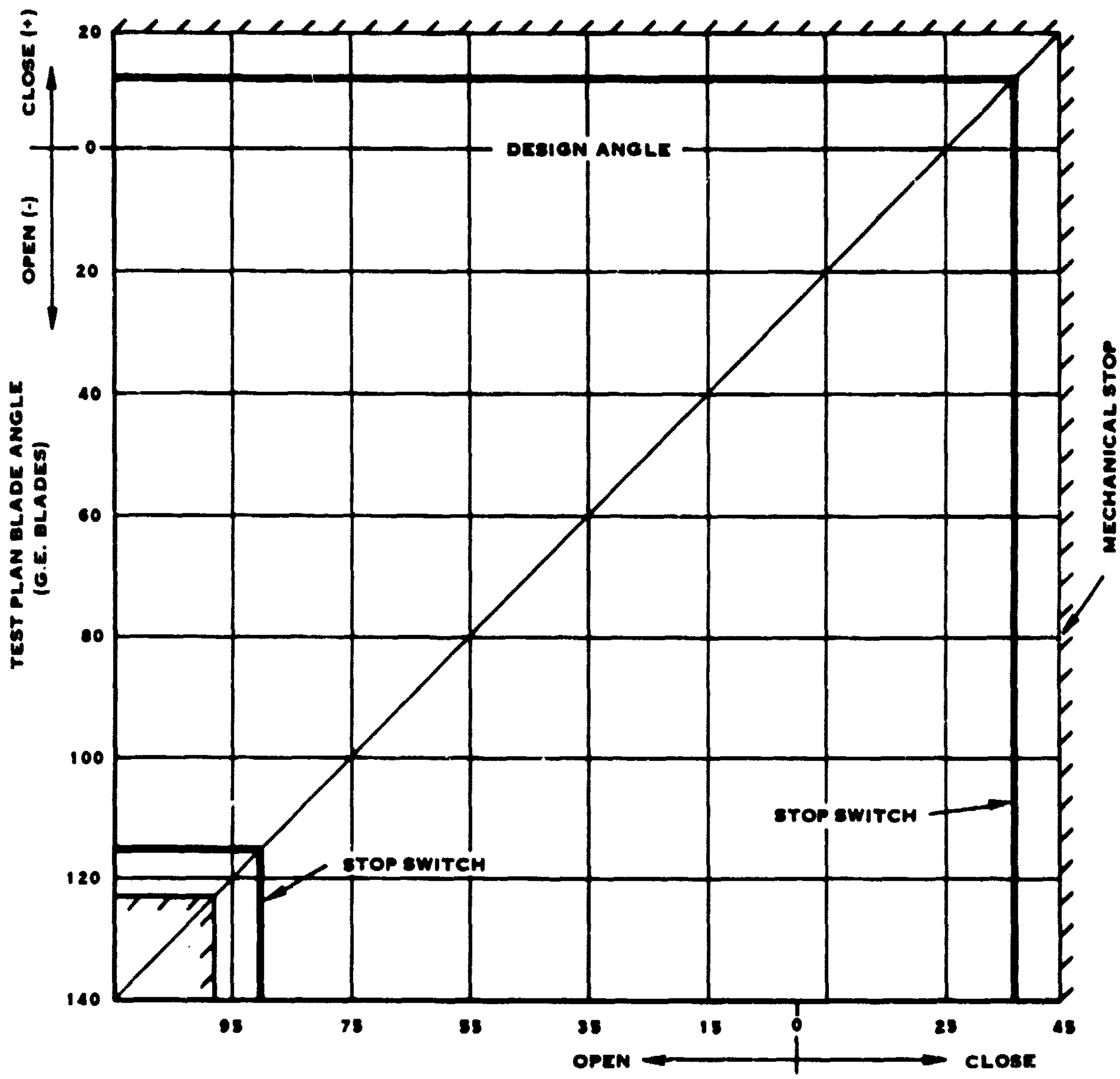

FIGURE 4. QCSEE PITCH CHANGE ACTUATOR TEST PLAN BLADE ANGLE VS. COUNTERWEIGHT ANGLE (TEST PLAN 222 PT-31 REV. A)

QCSEE ACTUATOR

WHIRL RIG CHECK LIST

Pre Operation

1. Actuator assembled per HS6971
2. System is correctly rigged and indexed
3. Feedback blade angle agrees with actual angle
4. Instrumentation secured
5. Cell cleaned
6. Hydraulic supply pump on
7. Lubrication supply pump on
8. Scavenge pump on

Post Operation

1. Check for leaks
2. Check feedback vs. actual blade angle
3. All required data recorded

FIGURE 5

HS F-927 6/56

TEST NO. 222PT-38

HSER 7002

HAMILTON STANDARD

PAGE 1 OF 3

Date: 1-30-76

PLAN OF TEST

JOB: 763500 Actuator with Soft Quill Shaft

PLAN PREPARED BY: D. E. Smith

PROJECT & ORDER: GE 200-4XX-14G-38570

APPROVED BY:

INSTRUCTION:

TEST ENGINEER:

TIME PERIOD: TO

1. WHAT IS ITEM BEING TESTED?

2. WHY IS TEST BEING RUN? WHAT WILL RESULTS SHOW OR BE USED FOR?

3. DESCRIBE TEST SET UP INCLUDING INSTRUMENTATION. ATTACH SKETCH OF INSTALLATION.

4. ITEMIZE RUNS TO BE MADE GIVING LENGTH OF EACH AND READINGS TO BE TAKEN.

5. SPECIAL INSTRUCTIONS: SAFETY PRECAUTIONS FOR OPERATORS AND HANDLING EQUIPMENT. OBSERVATIONS BY SIGHT, FEEL, OR HEARING. LIST POINTS OF OBSERVATION WHICH MIGHT CONTRIBUTE TO ANALYSIS OF (A) PERFORMANCE OF UNITS, (B) INCIPIENT TROUBLE BEFORE IT OCCURS, AND (C) CAUSE OF FAILURE.

6. HOW WILL DATA BE USED OR FINALLY PRESENTED? GIVE SAMPLE PLOT, CURVE, OR TABULATION AS IT WILL BE FINALLY PRESENTED.

ORIGINAL PAGE IS OF POOR QUALITY

NUMBER ENTRY AS LISTED ABOVE AND DESCRIBE BELOW

1.0 The item being tested is the pitch change actuator for the QCSEE with a soft quill shaft (snubber). (Ref. 763500-1 Rev. D)

2.0 The test is being run to evaluate the performance of the actuator system incorporating a soft quill shaft to reduce the impact loading on the no-back output shaft.

3.0 The actuator will be installed in G-7 Whirl Rig as defined in 222PT-31 Rev. A. The spindle retaining nut torque will be adjusted to obtain 600-700 in. lbs. of drag torque on each spindle. Retaining nut torque and drag torque will be recorded for each arm bore.

This test will be conducted when the disc is installed on the rig and the spindle torque will be rechecked (without changing retaining nut position) prior to disassembling disc.

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HAMILTON STANDARD

PLAN OF TEST

Test No. 222PT-38

Date: 1-30-76

Job: 763500 Actuator with Soft Quill Shaft

Prepared by: D. E. Smith

Project & Order GE 200-4XX-14G-38570

4.0 The following tests will be conducted.

4.1 System Losses

The torque to move the blades will be measured at the beta regulator manual drive when the installation is complete, after each reassembly and following completion of the 50 flight cycles. Torque will be measured in both directions of motion at +10°, 0° and -100° of blade angle.

4.2 Blade Angle Calibration

The LVDT's will be calibrated against the position of the counterweights, for both directions of motion. Calibration will be in approximately 2° increments between +12 and -10° and 10° increments from -10° to -100°.

4.3 Stop Switches

Stop switches shall be set 6.5°-7° from the mechanical stops. Stop angle and switch setting will be recorded.

4.4 Max Rate Testing (Ref. 4.5.3 of 222PT-31A)

After checking system operation over entire range and adjusting control settings, perform a reverse transient at 3315 fan rpm and 3450 psi EHV supply pressure. Pump stroke should be adjusted for 10,000 ± 500 rpm flex shaft speed. Reduce rig speed to 2700 rpm and unreverse at 10,000 ± 500 rpm. Repeat test to obtain two (2) cycles and remove and examine no back and snubber. Determine wind up which snubber experienced.

Reassemble no back and install in rig. Repeat test at 17,500 ± 500 flex shaft rpm. Remove and examine no back and snubber and record snubber wind up.

4.5 Endurance Test

Conduct fifty (50) cycles of endurance testing in accordance with paragraph 4.7.2 of 222PT-31A. Max flex shaft speed will be adjusted to achieve 17500 ± 500 rpm during reverse transient portion of run. Following the endurance test, the no back and snubber hardware will be examined.

Test No. 222PT-38 HAMILTON STANDARD

HSER 7002

Date: 1-30-76

Job: 763500 Actuator with Soft Quill Shaft Prepared by: D. E. Smith

Project & Order GE 200-4XX-14G-38570

4.6 Limit Switch Overtravel

The amount of blade travel required to stop, after tripping the travel limit switches, will be determined at both ends of the operating range. Test will be run statically. For each end of travel, the stopping distance will be determined for flex shaft speeds of 10,000, 12,000, 15,000 and 17,500 rpm (± 500 rpm). The control time constant will be set for .02 seconds initially. If necessary to increase this time constant, the new value shall be recorded on the log sheet.

4.7 Frequency Response

The static frequency response shall be measured as described in 4.6.1 of 222PT-31A.

5.0 Same as 222PT-31 Rev. A.

6.0 Same as 222PT-31 Rev. A.

APPENDIX C

SANBORN RECORDS

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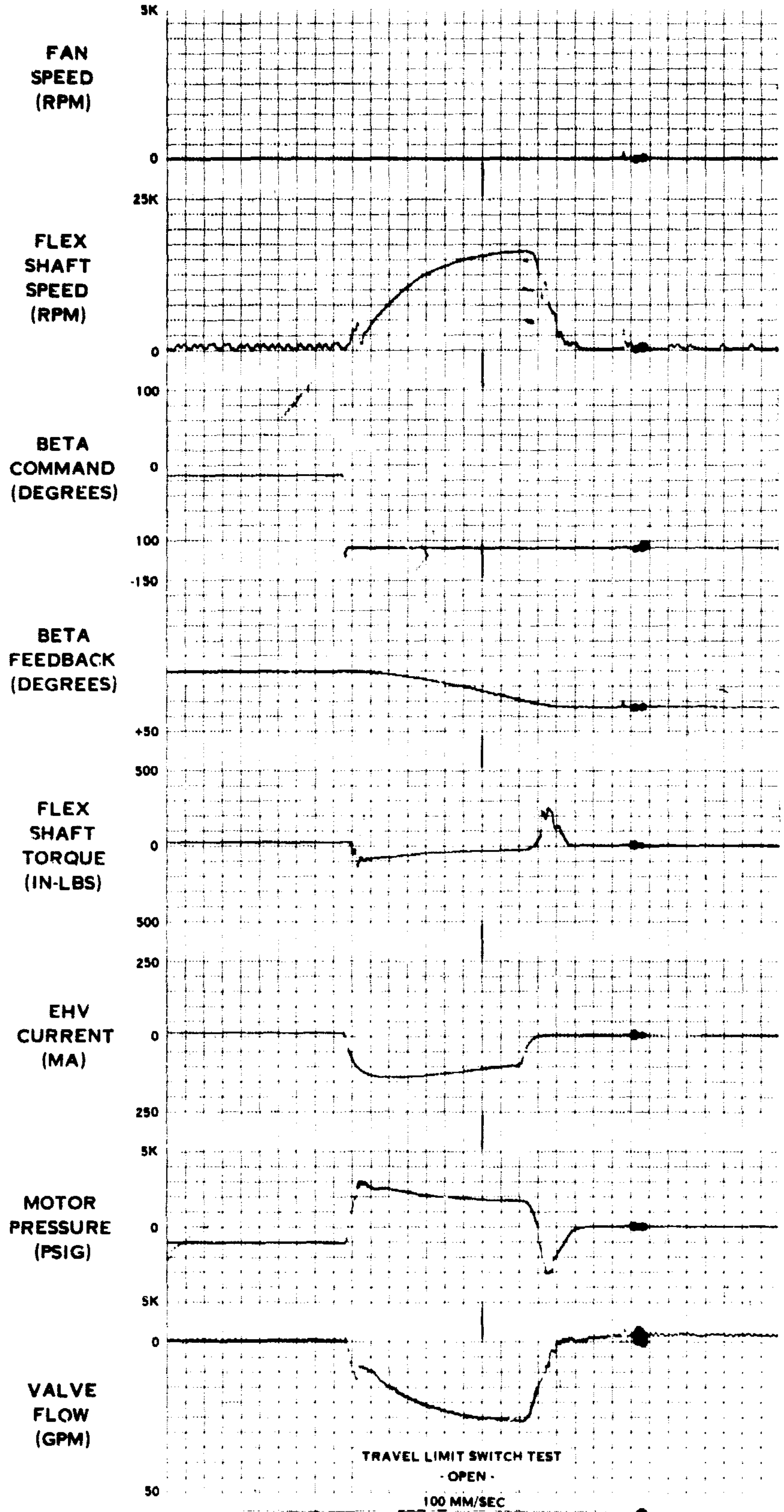

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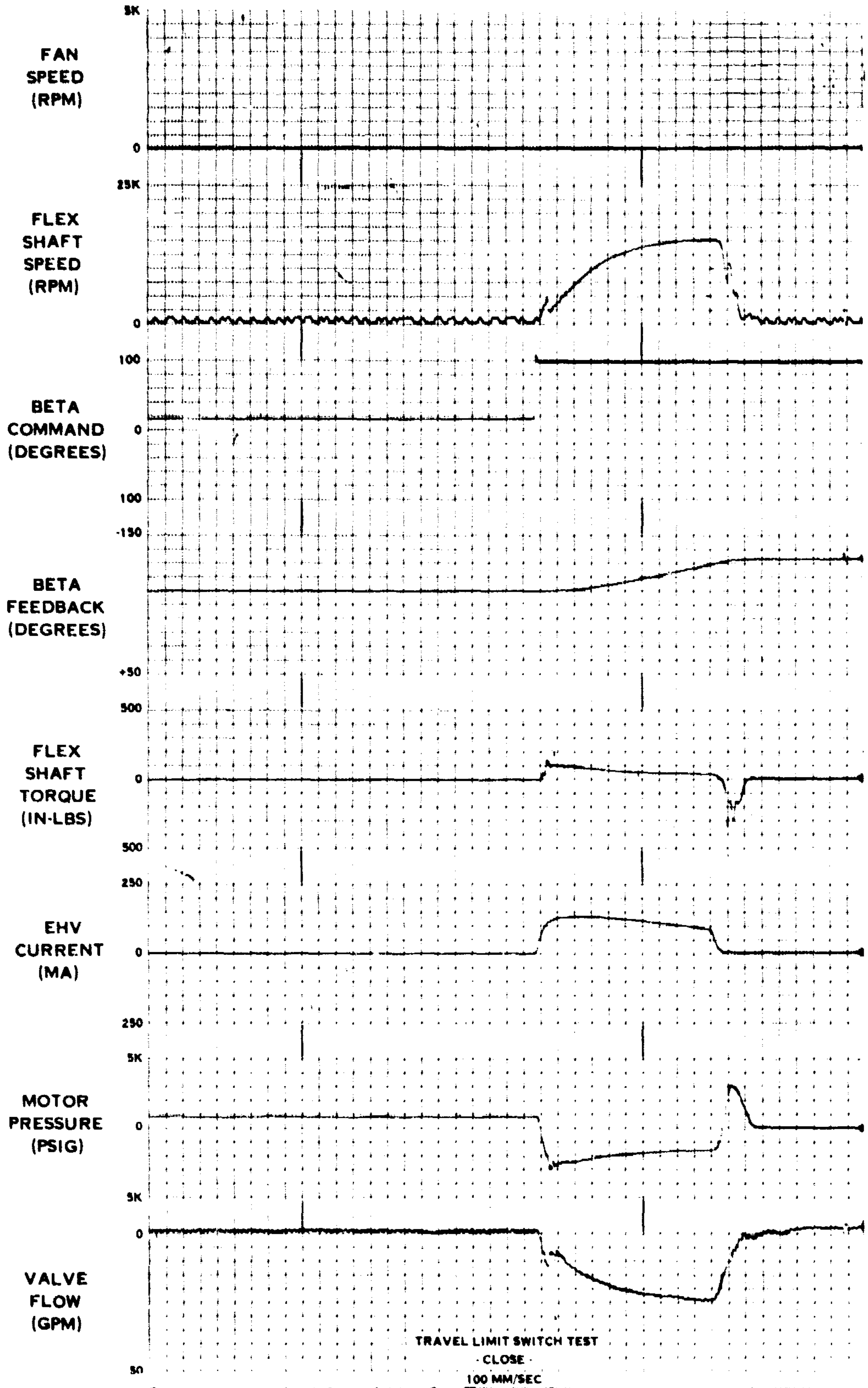
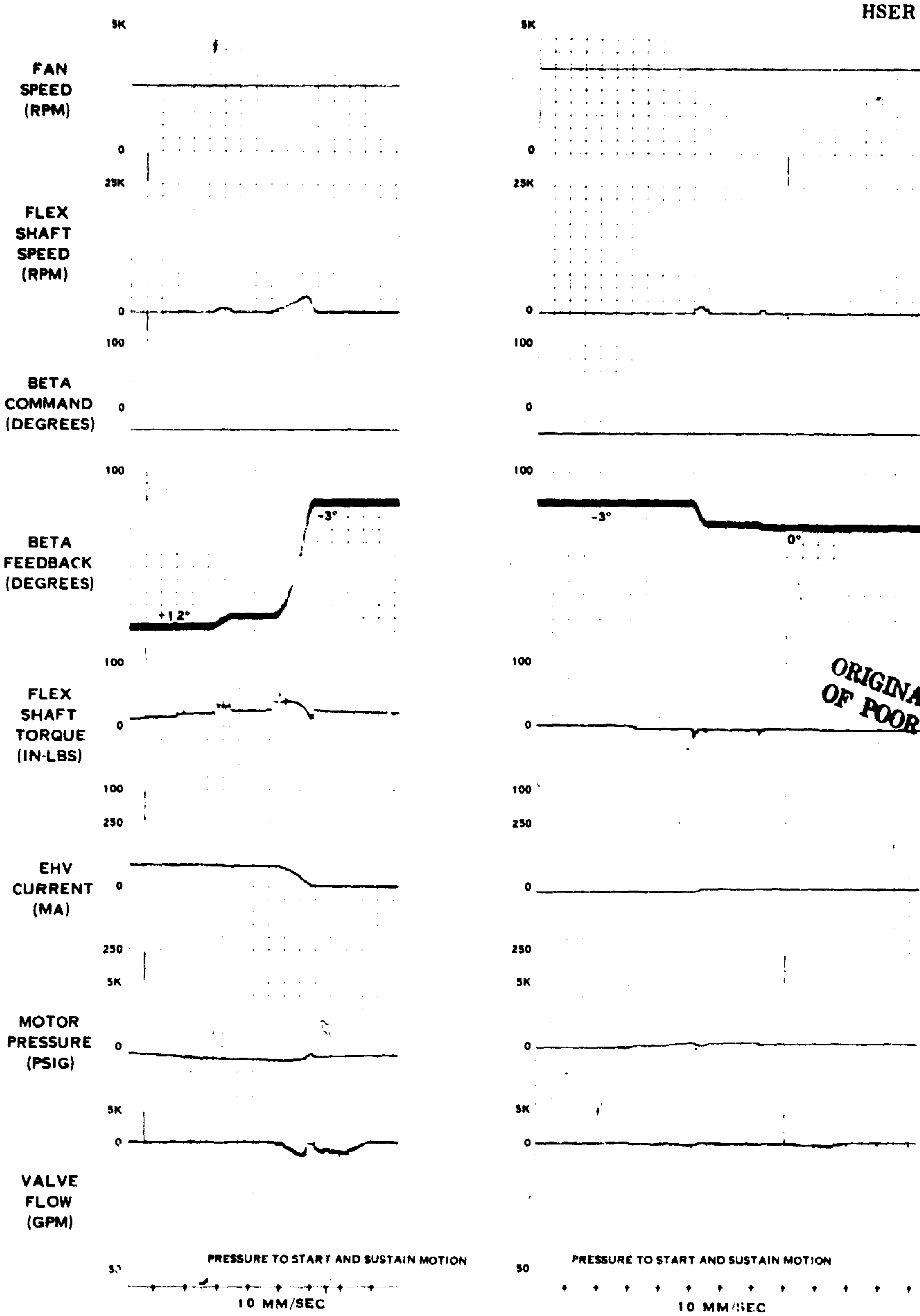
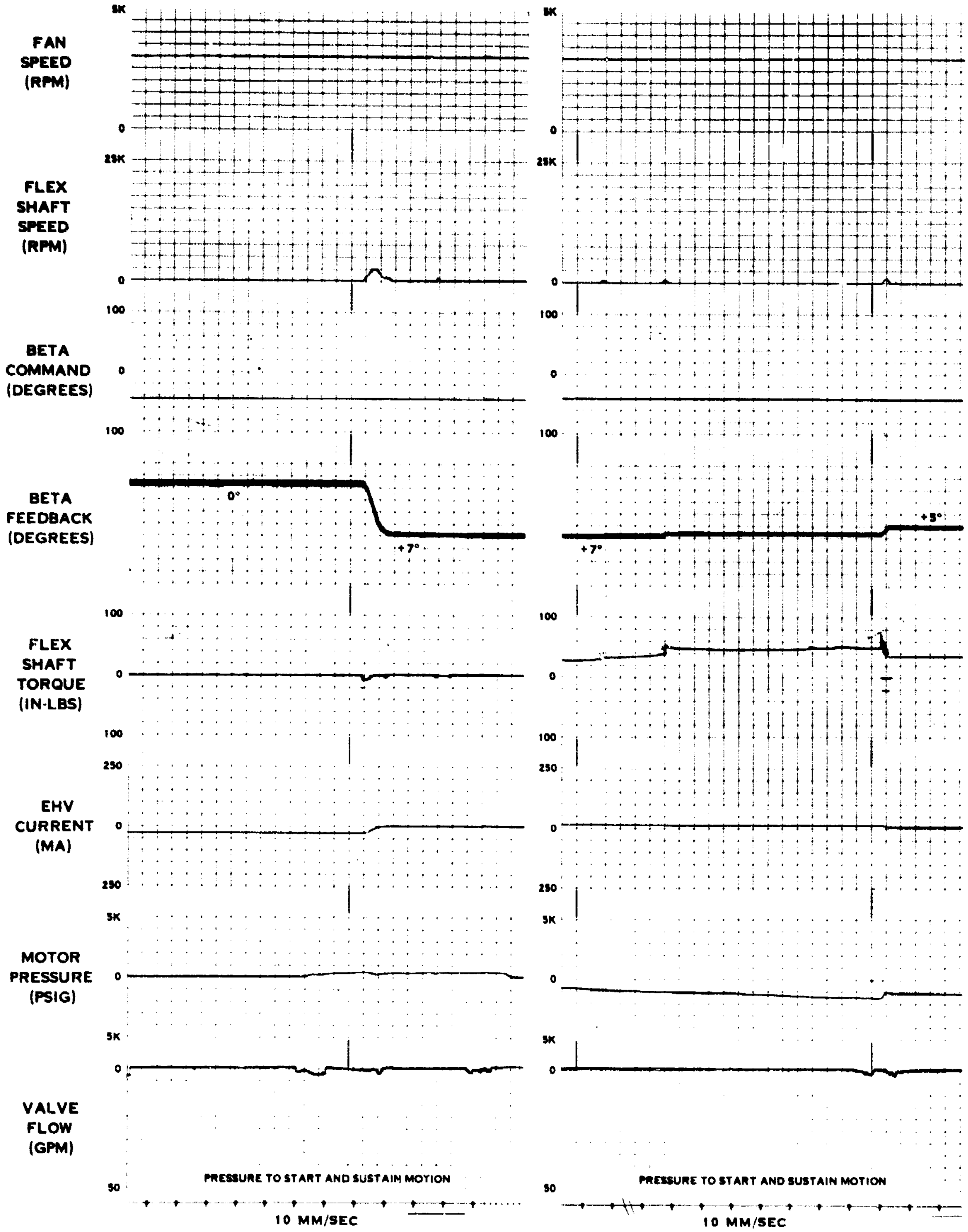


5K
FAN SPEED (RPM)
0
25K
FLEX SHAFT SPEED (RPM)
0
100
BETA COMMAND (DEGREES)
0
100
-150
BETA FEEDBACK (DEGREES)
+50
500
FLEX SHAFT TORQUE (IN-LBS)
0
500
250
EHV CURRENT (MA)
0
250
5K
MOTOR PRESSURE (PSIG)
0
5K
0
VALVE FLOW (GPM)
50
TRAVEL LIMIT SWITCH TEST
- CLOSE -
100 MM/SEC


FAN SPEED (RPM)
5K
0
FLEX SHAFT SPEED (RPM)
25K
0
BETA COMMAND (DEGREES)
100
0
100
BETA FEEDBACK (DEGREES)
100
+12°
-3°
0°
100
FLEX SHAFT TORQUE (IN-LBS)
0
100
EHV CURRENT (MA)
250
0
250
MOTOR PRESSURE (PSIG)
5K
0
VALVE FLOW (GPM)
5K
0
50
PRESSURE TO START AND SUSTAIN MOTION
10 MM/SEC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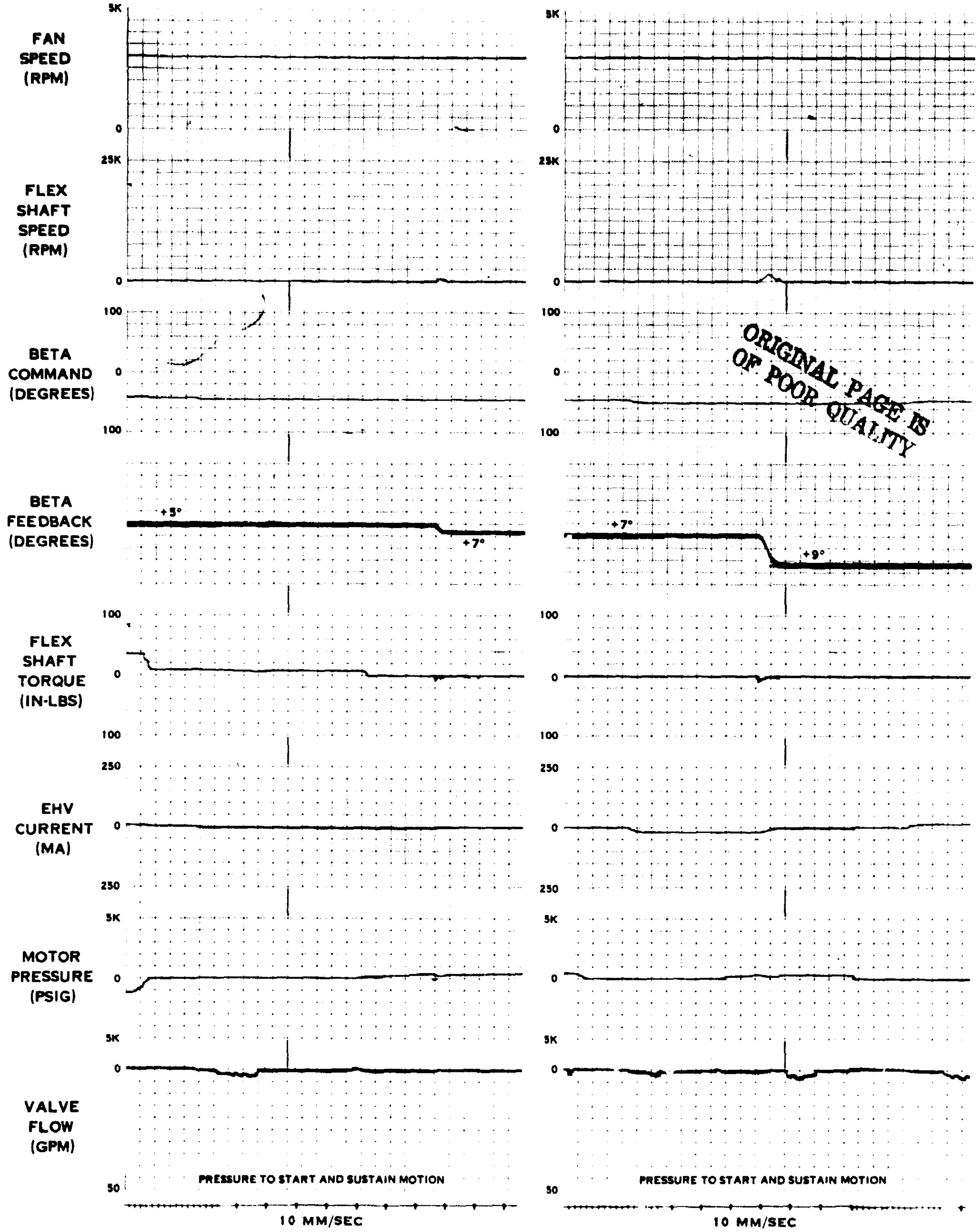
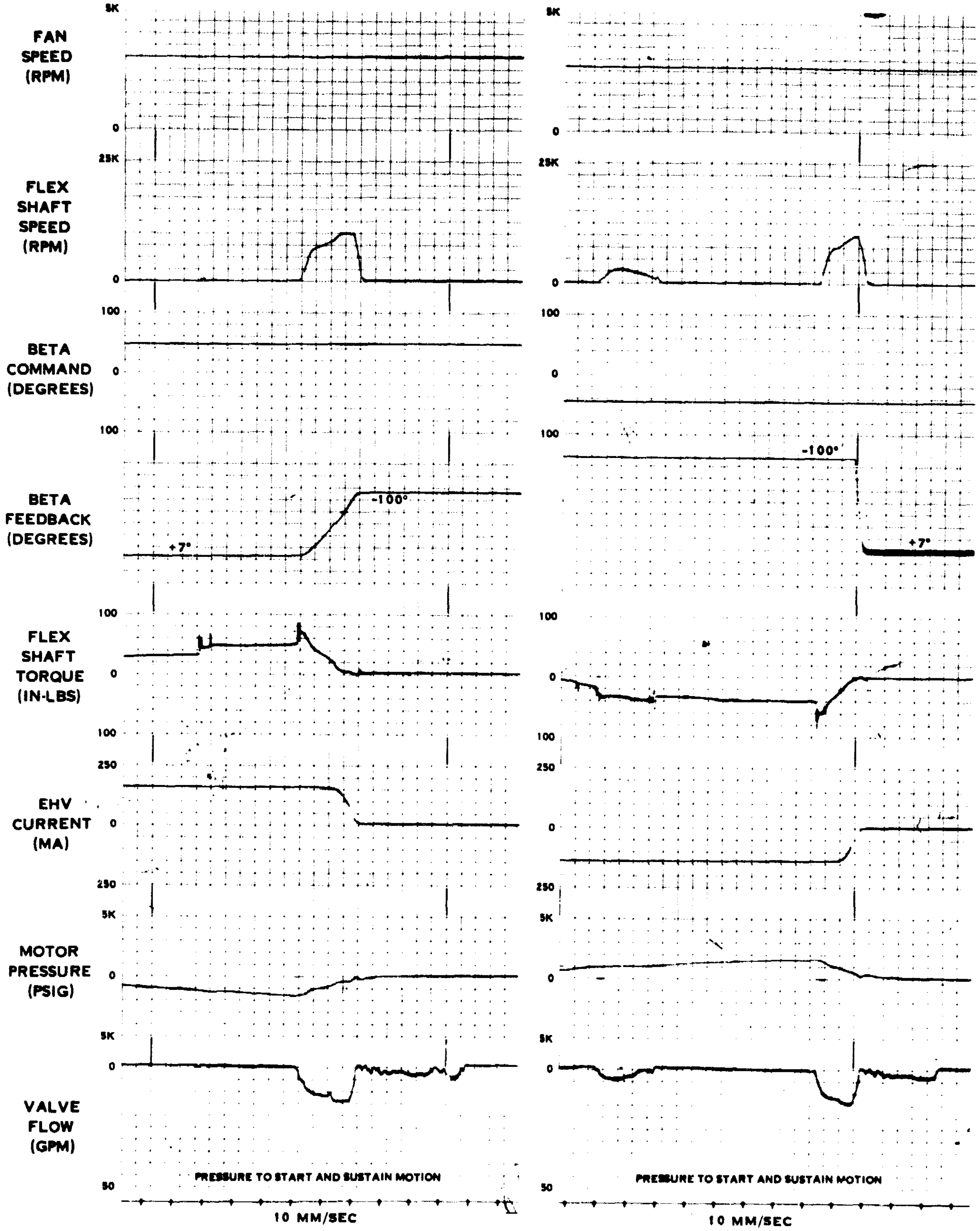
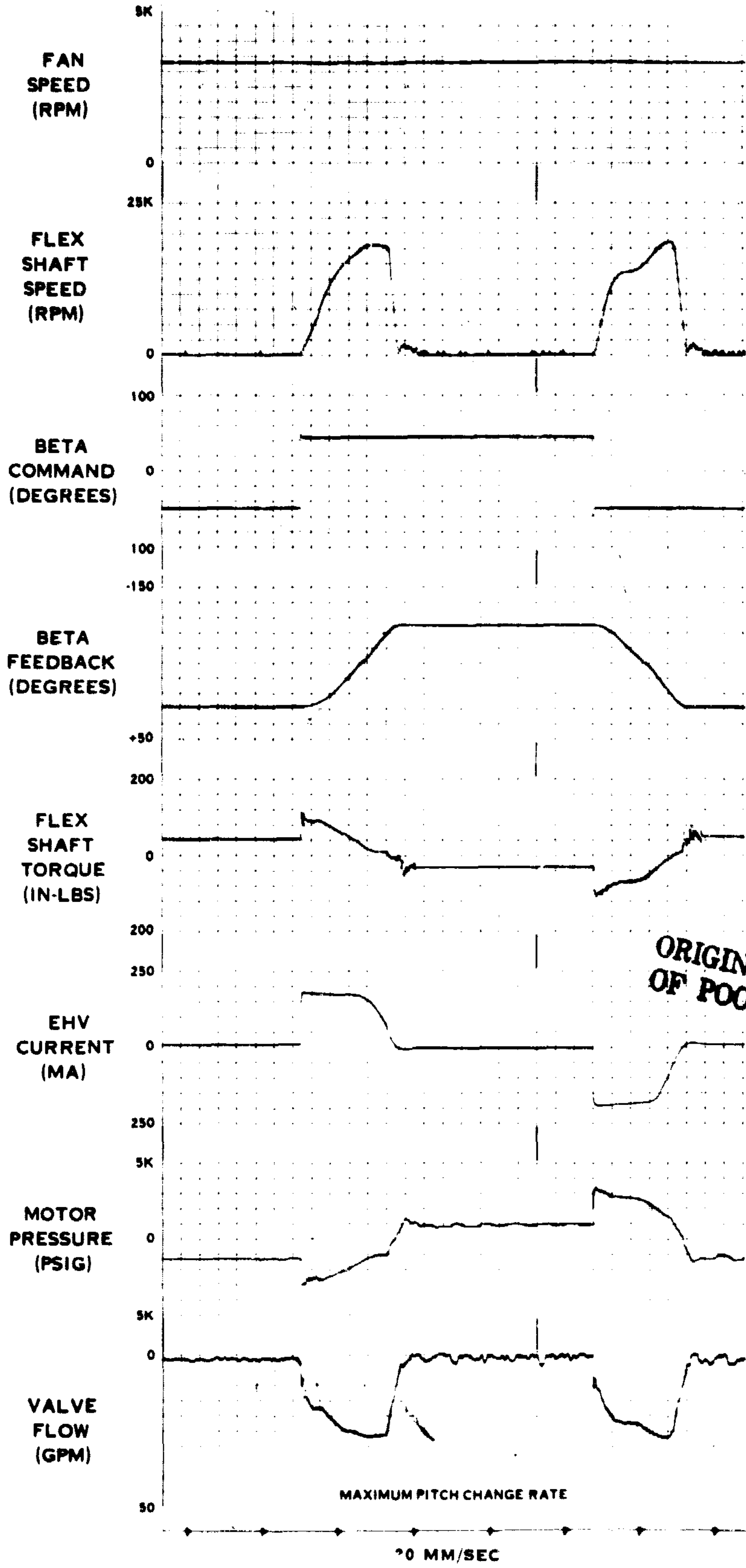
0
25K
FLEX SHAFT SPEED (RPM)
0
100
BETA COMMAND (DEGREES)
0
100
BETA FEEDBACK (DEGREES)
0°
+7°
+7°
+5°
100
FLEX SHAFT TORQUE (IN-LBS)
0
100
250
EHV CURRENT (MA)
0
250
5K
MOTOR PRESSURE (PSIG)
0
5K
0
VALVE FLOW (GPM)
50
PRESSURE TO START AND SUSTAIN MOTION
PRESSURE TO START AND SUSTAIN MOTION
10 MM/SEC
10 MM/SEC

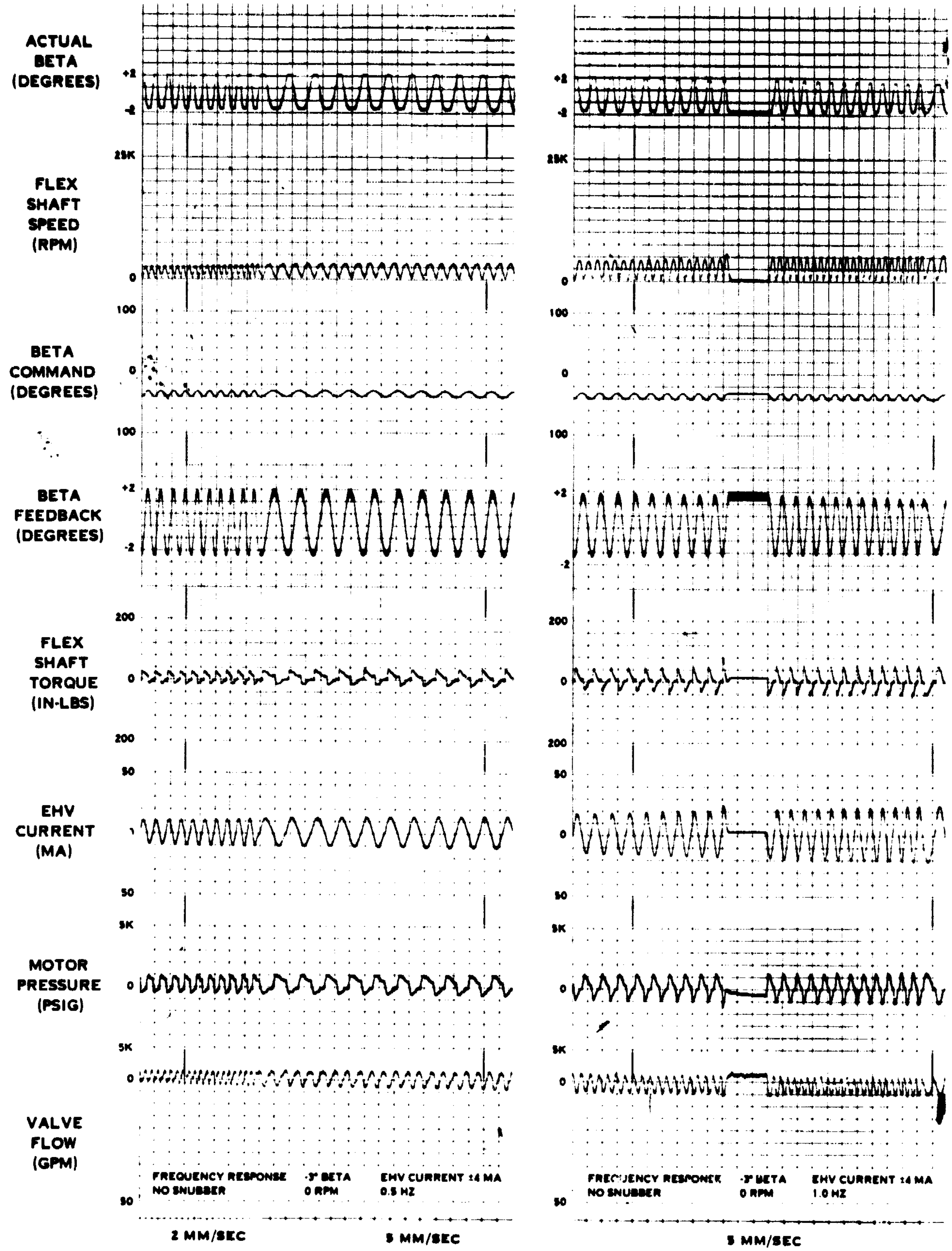

FAN SPEED (RPM)
5K
0
FLEX SHAFT SPEED (RPM)
25K
0
BETA COMMAND (DEGREES)
100
0
100
BETA FEEDBACK (DEGREES)
+5°
+7°
+7°
+9°
FLEX SHAFT TORQUE (IN-LBS)
100
0
100
EHV CURRENT (MA)
250
0
250
MOTOR PRESSURE (PSIG)
5K
0
5K
VALVE FLOW (GPM)
0
50
PRESSURE TO START AND SUSTAIN MOTION
PRESSURE TO START AND SUSTAIN MOTION
10 MM/SEC
10 MM/SEC
ORIGINAL PAGE IS OF POOR QUALITY

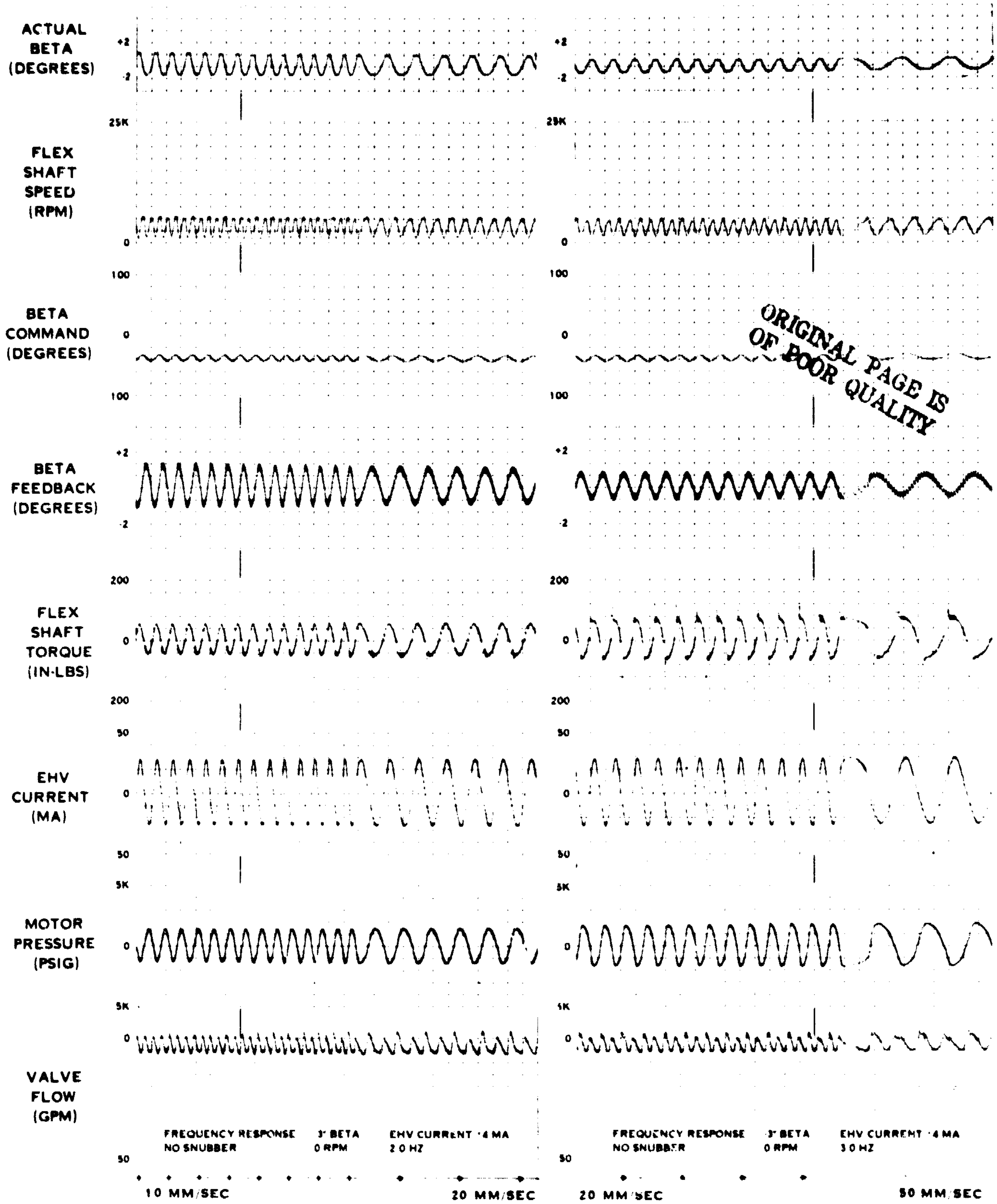


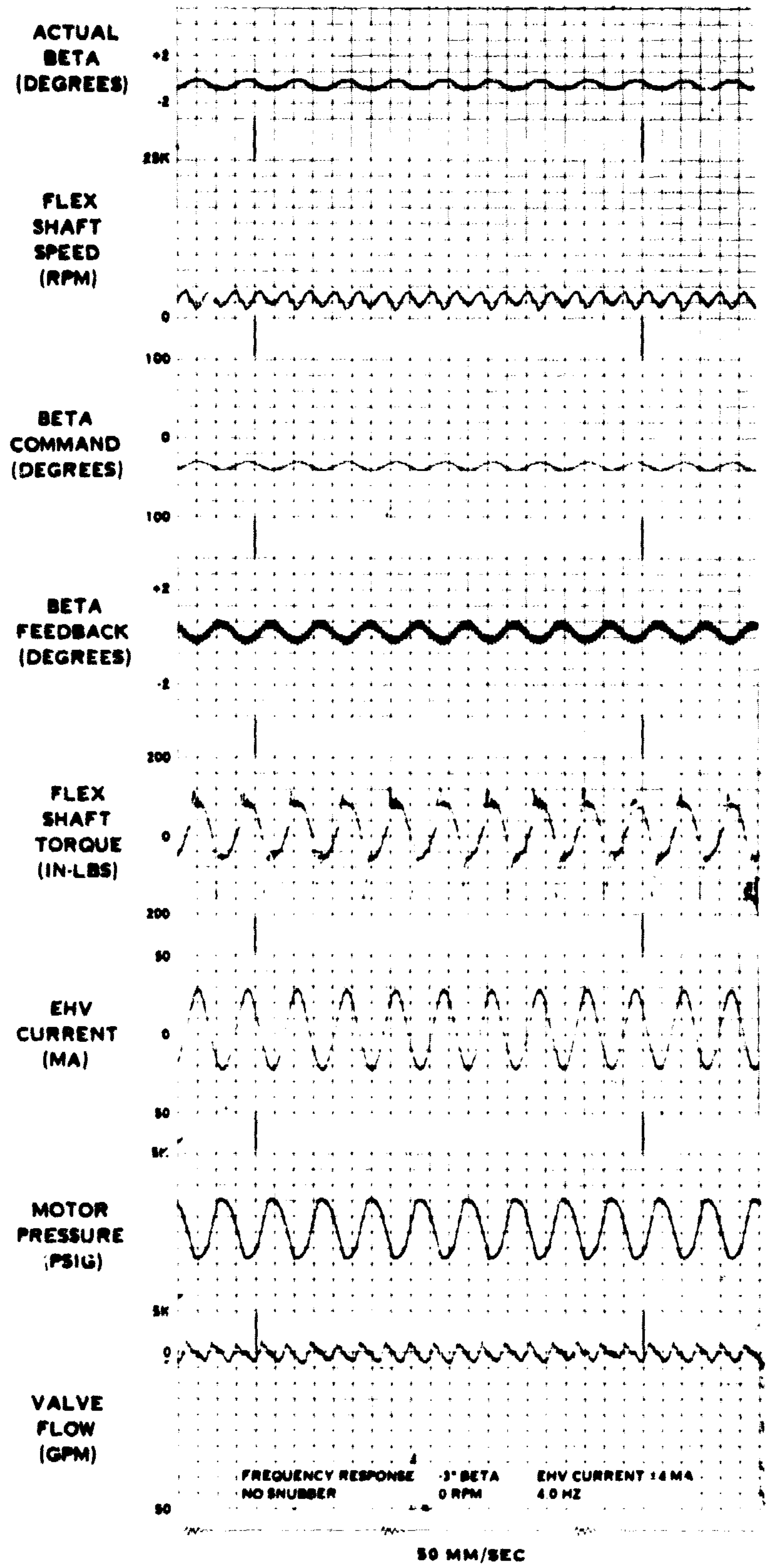
FAN SPEED (RPM)
5K
0
FLEX SHAFT SPEED (RPM)
25K
0
BETA COMMAND (DEGREES)
100
0
BETA FEEDBACK (DEGREES)
100
-100°
+7°
FLEX SHAFT TORQUE (IN-LBS)
100
0
100
EHV CURRENT (MA)
250
0
250
MOTOR PRESSURE (PSIG)
5K
0
VALVE FLOW (GPM)
5K
0
50
PRESSURE TO START AND SUSTAIN MOTION
10 MM/SEC

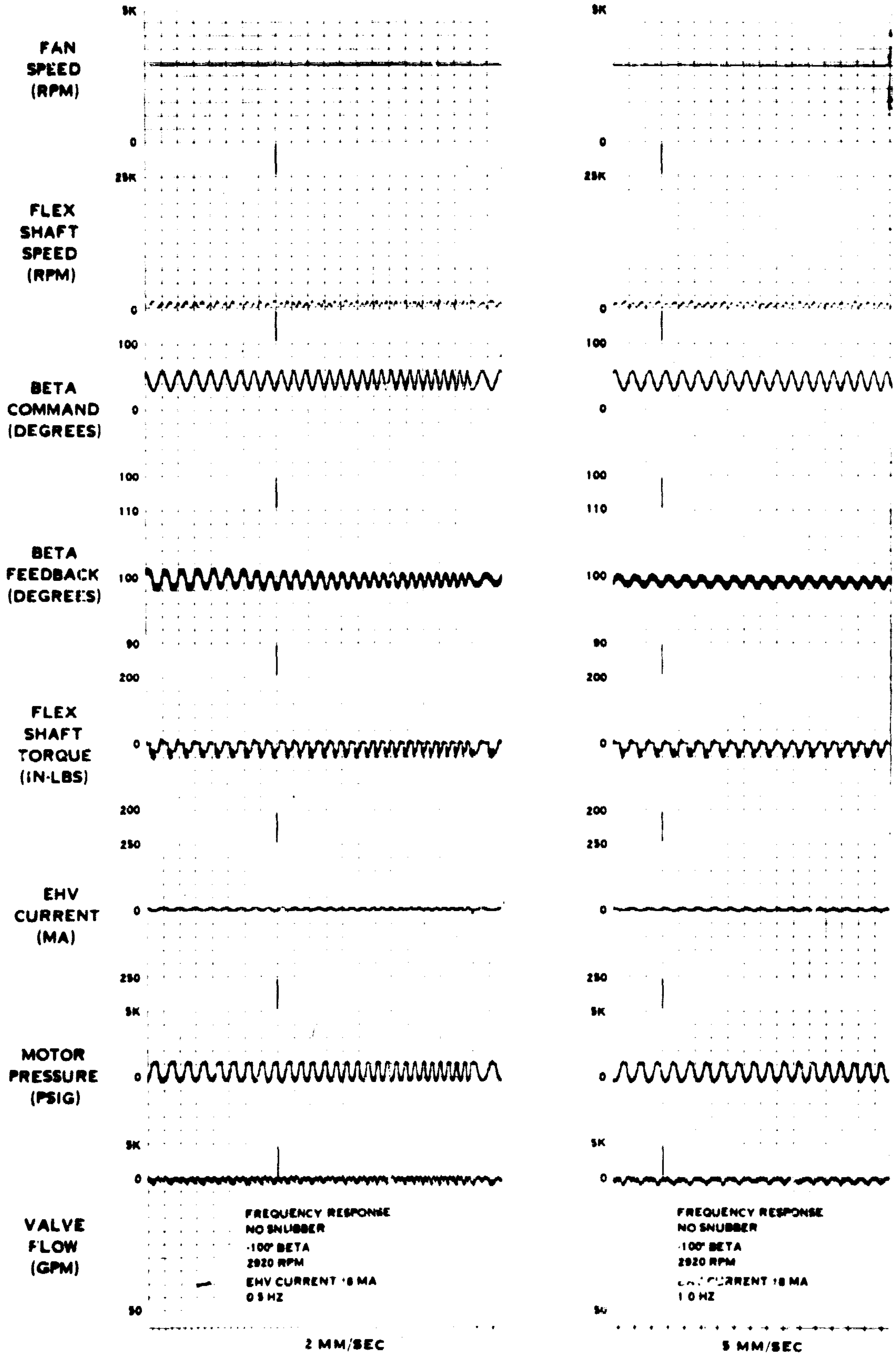


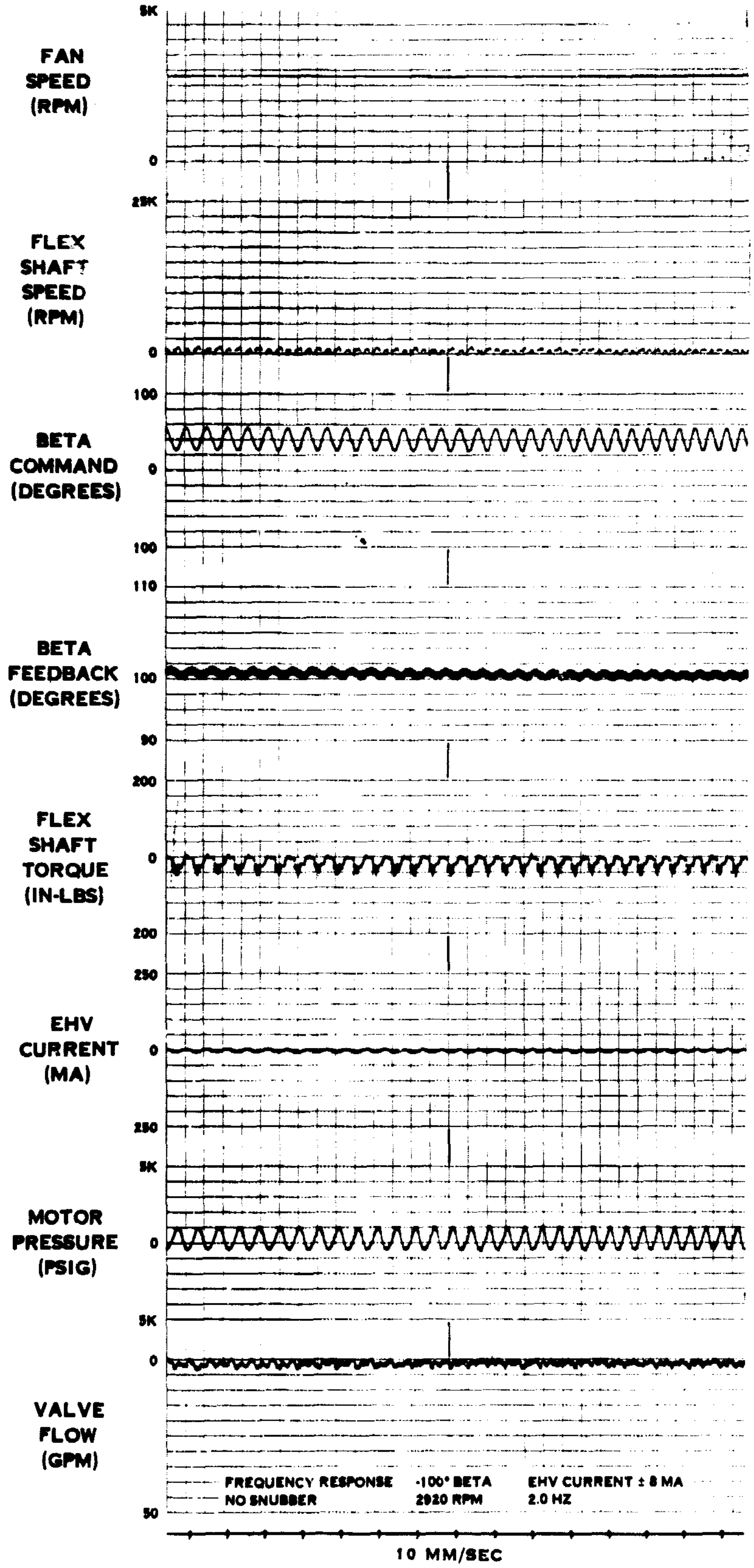
ORIGINAL PAGE IS OF POOR QUALITY


ACTUAL BETA (DEGREES)
FLEX SHAFT SPEED (RPM)
BETA COMMAND (DEGREES)
BETA FEEDBACK (DEGREES)
FLEX SHAFT TORQUE (IN-LBS)
EHV CURRENT (MA)
MOTOR PRESSURE (PSIG)
VALVE FLOW (GPM)
+2
-2
25K
0
100
0
100
+2
-2
200
0
200
50
0
50
5K
0
5K
0
50
FREQUENCY RESPONSE NO SNUBBER
-3° BETA 0 RPM
EHV CURRENT ±4 MA 0.5 HZ
FREQUENCY RESPONSE NO SNUBBER
-3° BETA 0 RPM
EHV CURRENT ±4 MA 1.0 HZ
2 MM/SEC
5 MM/SEC
5 MM/SEC

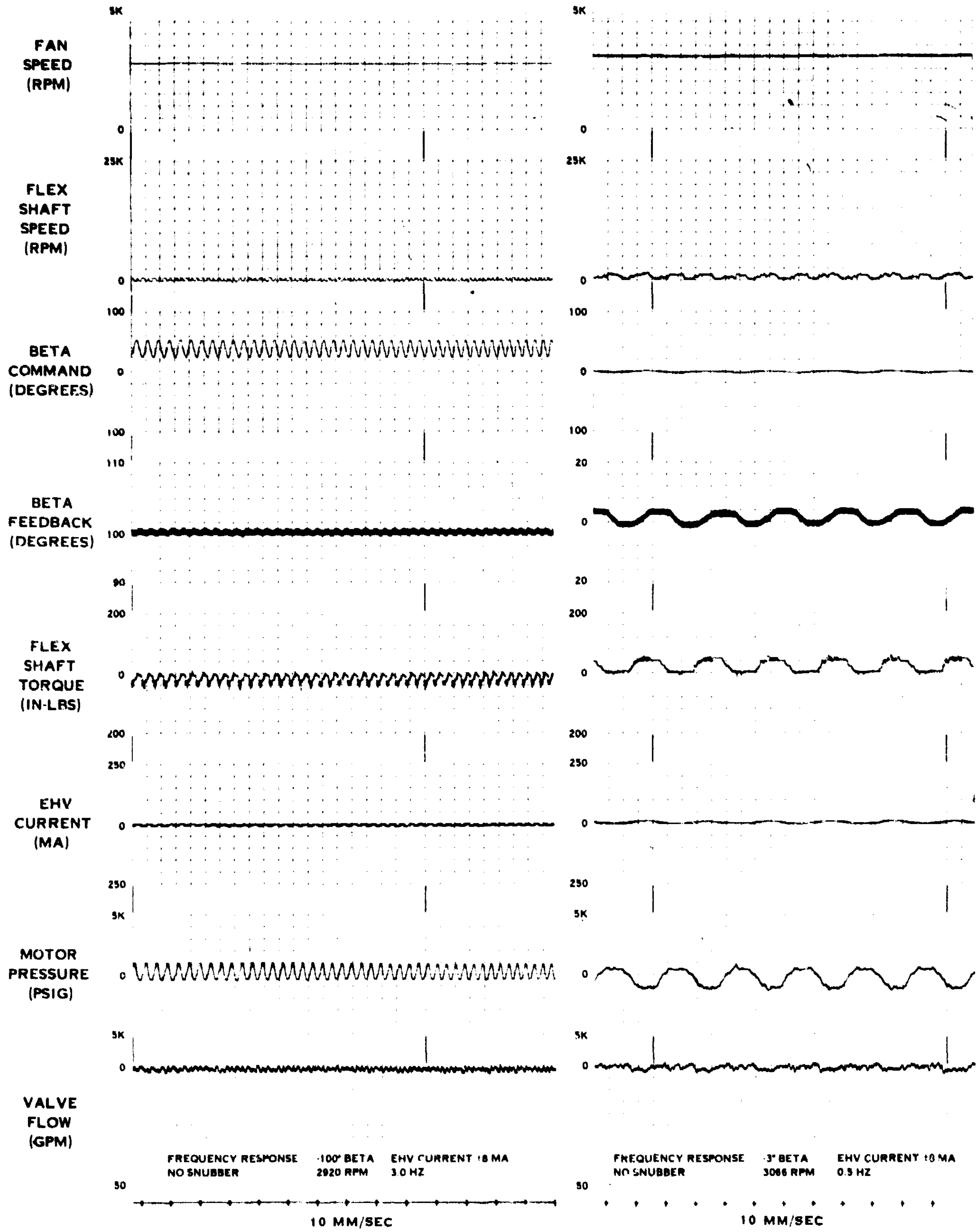

ACTUAL BETA (DEGREES)
+2
-2
FLEX SHAFT SPEED (RPM)
25K
0
BETA COMMAND (DEGREES)
100
0
100
BETA FEEDBACK (DEGREES)
+2
-2
FLEX SHAFT TORQUE (IN-LBS)
200
0
200
EHV CURRENT (MA)
50
0
50
MOTOR PRESSURE (PSIG)
5K
0
5K
VALVE FLOW (GPM)
0
50
FREQUENCY RESPONSE NO SNUBBER
3° BETA 0 RPM
EHV CURRENT ·4 MA 2.0 HZ
FREQUENCY RESPONSE NO SNUBBER
3° BETA 0 RPM
EHV CURRENT ·4 MA 3.0 HZ
10 MM/SEC
20 MM/SEC
20 MM/SEC
50 MM/SEC

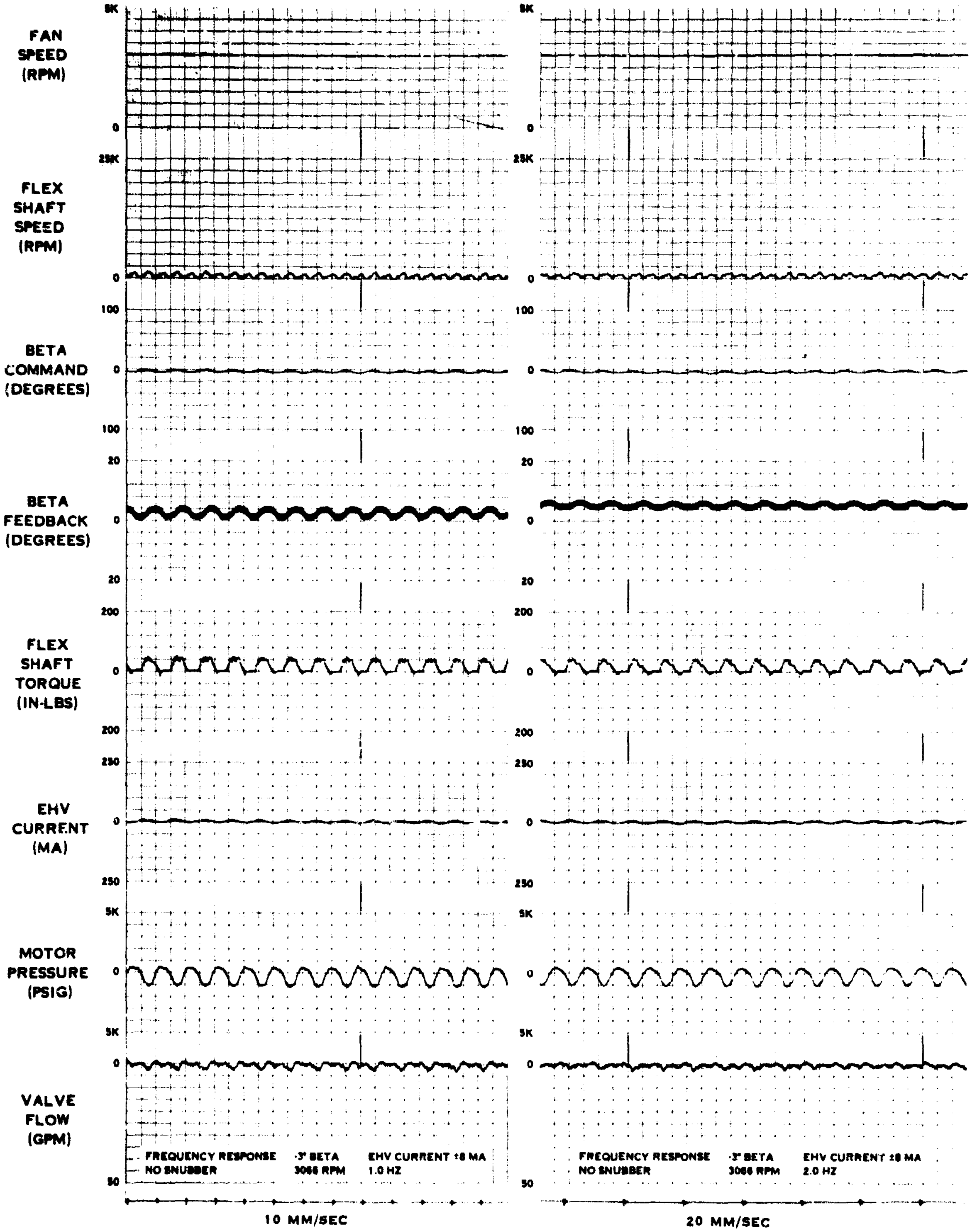

ACTUAL BETA (DEGREES)
+2
-2
25K
FLEX SHAFT SPEED (RPM)
0
100
BETA COMMAND (DEGREES)
0
100
+2
BETA FEEDBACK (DEGREES)
-2
200
FLEX SHAFT TORQUE (IN-LBS)
0
200
50
EHV CURRENT (MA)
0
50
5K
MOTOR PRESSURE (PSIG)
5K
0
VALVE FLOW (GPM)
50
FREQUENCY RESPONSE
NO SNUBBER
-3° BETA
0 RPM
EHV CURRENT ±4 MA
4.0 HZ
50 MM/SEC

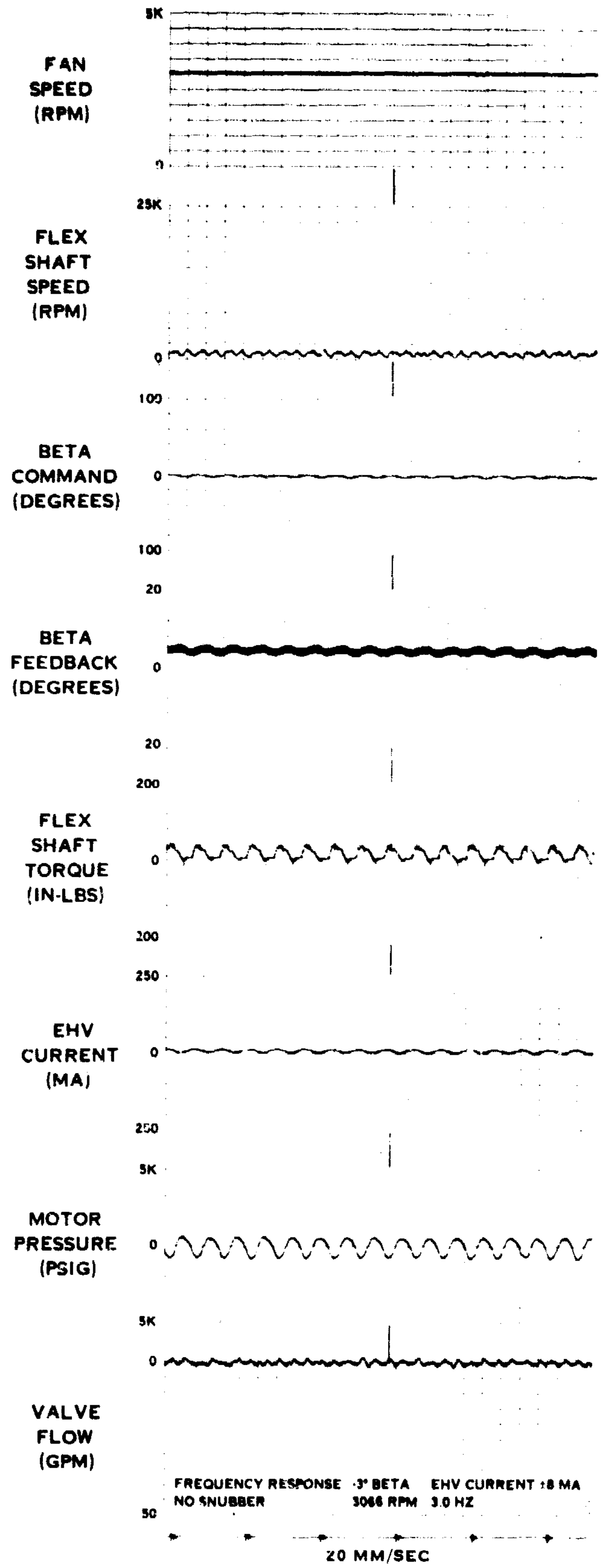

FAN SPEED (RPM)
FLEX SHAFT SPEED (RPM)
BETA COMMAND (DEGREES)
BETA FEEDBACK (DEGREES)
FLEX SHAFT TORQUE (IN-LBS)
EHV CURRENT (MA)
MOTOR PRESSURE (PSIG)
VALVE FLOW (GPM)
FREQUENCY RESPONSE
NO SNUBBER
-100° BETA
2920 RPM
EHV CURRENT ±8 MA
0.5 HZ
2 MM/SEC
FREQUENCY RESPONSE
NO SNUBBER
-100° BETA
2920 RPM
1.0 HZ
5 MM/SEC


FAN SPEED (RPM)
5K
0
25K
FLEX SHAFT SPEED (RPM)
0
100
BETA COMMAND (DEGREES)
0
100
110
BETA FEEDBACK (DEGREES)
100
90
200
FLEX SHAFT TORQUE (IN-LBS)
0
200
250
EHV CURRENT (MA)
0
250
5K
MOTOR PRESSURE (PSIG)
0
5K
0
VALVE FLOW (GPM)
50
FREQUENCY RESPONSE
NO SNUBBER
-100° BETA
2920 RPM
EHV CURRENT ± 8 MA
2.0 HZ
10 MM/SEC

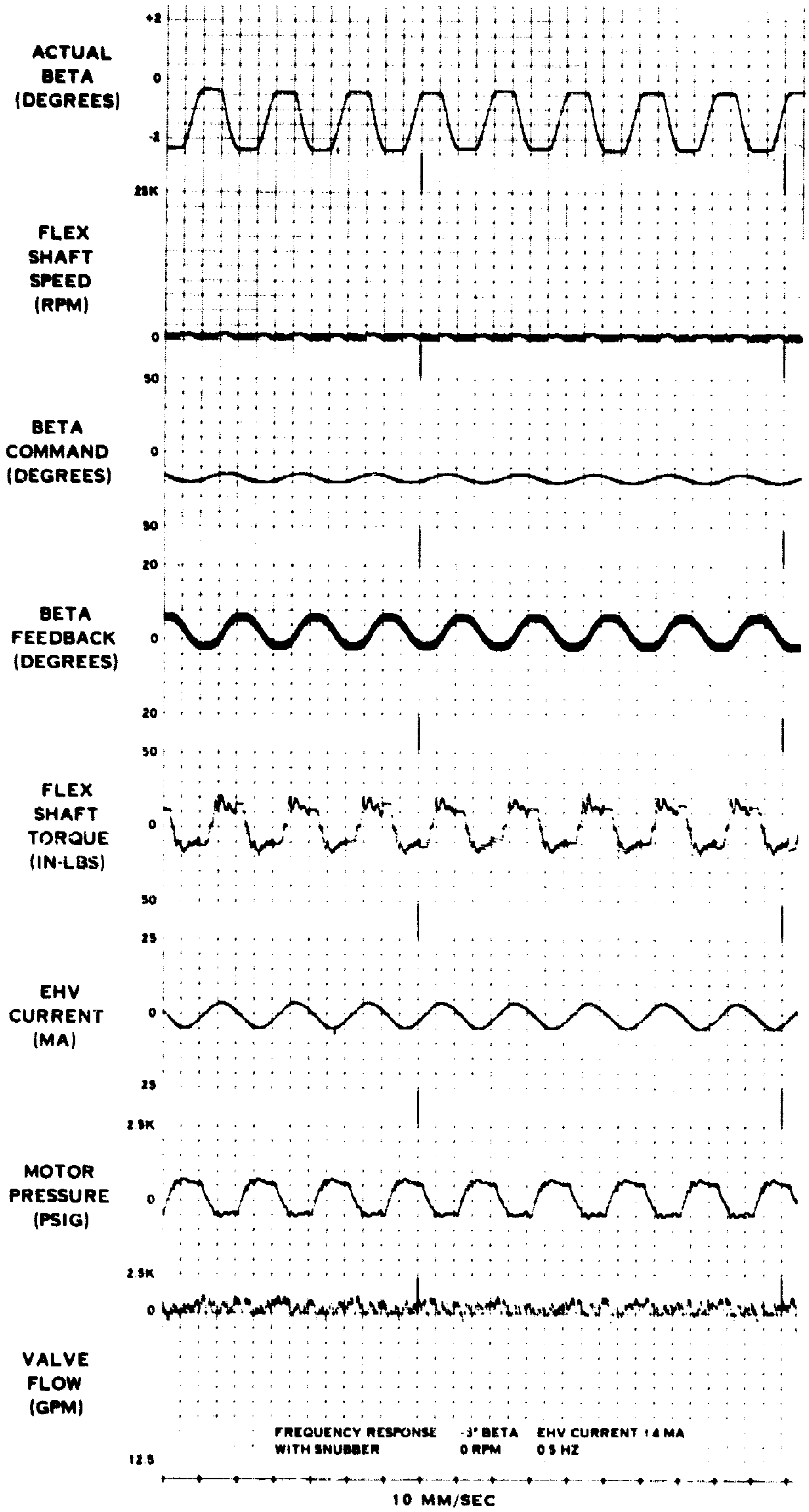
C-2

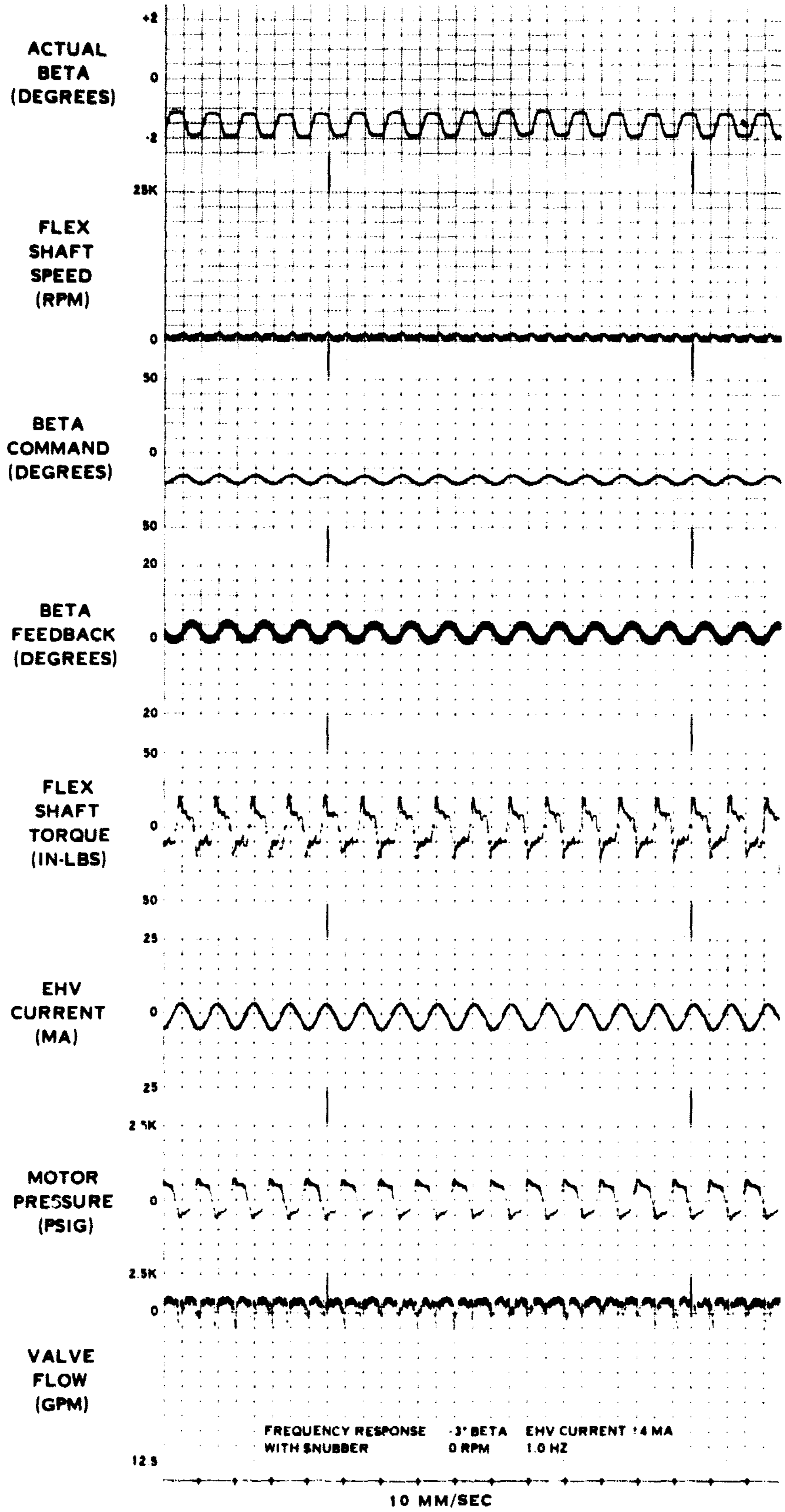

FAN SPEED (RPM)
FLEX SHAFT SPEED (RPM)
BETA COMMAND (DEGREES)
BETA FEEDBACK (DEGREES)
FLEX SHAFT TORQUE (IN-LBS)
EHV CURRENT (MA)
MOTOR PRESSURE (PSIG)
VALVE FLOW (GPM)
FREQUENCY RESPONSE NO SNUBBER
-100° BETA 2920 RPM
EHV CURRENT ±8 MA 3.0 HZ
10 MM/SEC
FREQUENCY RESPONSE NO SNUBBER
-3° BETA 3066 RPM
EHV CURRENT ±8 MA 0.5 HZ
10 MM/SEC


FAN SPEED (RPM)
5K
0
FLEX SHAFT SPEED (RPM)
25K
0
BETA COMMAND (DEGREES)
100
0
100
BETA FEEDBACK (DEGREES)
20
0
20
FLEX SHAFT TORQUE (IN-LBS)
200
0
200
EHV CURRENT (MA)
250
0
250
MOTOR PRESSURE (PSIG)
5K
0
5K
VALVE FLOW (GPM)
0
50
FREQUENCY RESPONSE NO SNUBBER
-3° BETA 3066 RPM
EHV CURRENT ±8 MA 1.0 HZ
EHV CURRENT ±8 MA 2.0 HZ
10 MM/SEC
20 MM/SEC

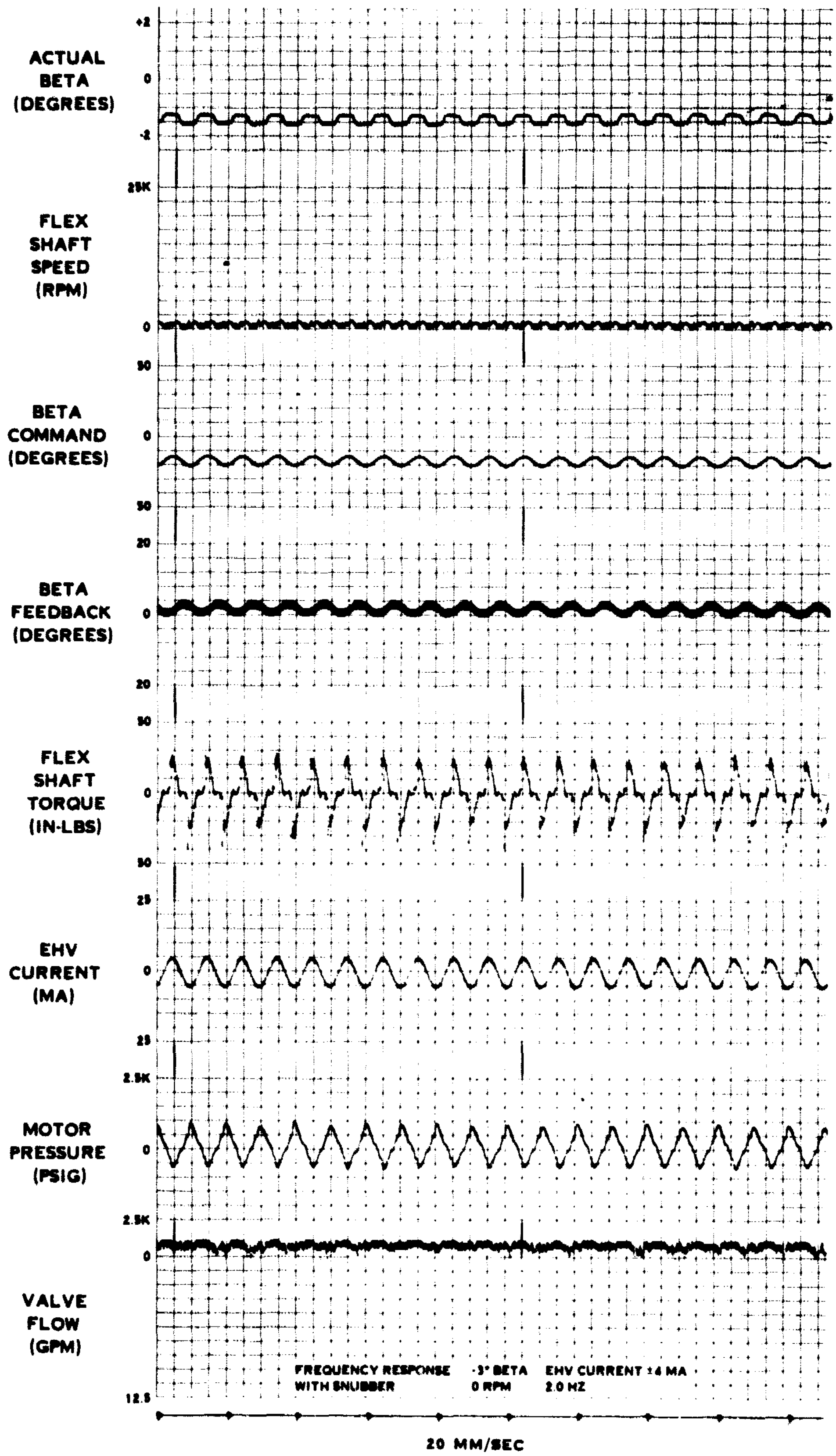


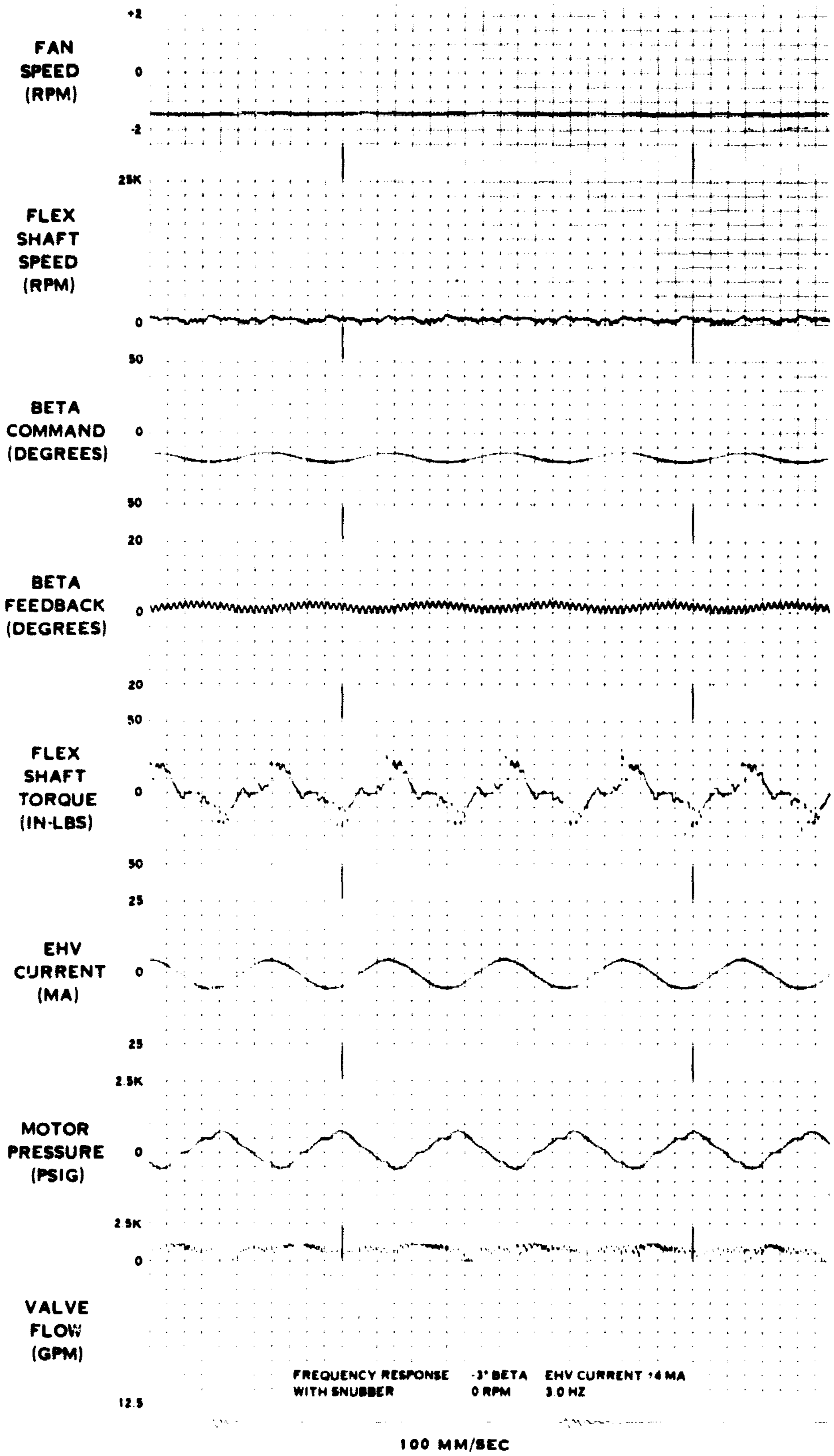
5K
FAN SPEED (RPM)
0
25K
FLEX SHAFT SPEED (RPM)
0
100
BETA COMMAND (DEGREES)
0
100
20
BETA FEEDBACK (DEGREES)
0
20
200
FLEX SHAFT TORQUE (IN-LBS)
0
200
250
EHV CURRENT (MA)
0
250
5K
MOTOR PRESSURE (PSIG)
0
5K
0
VALVE FLOW (GPM)
50
FREQUENCY RESPONSE -3° BETA EHV CURRENT ±8 MA
NO SNUBBER 3066 RPM 3.0 HZ
20 MM/SEC

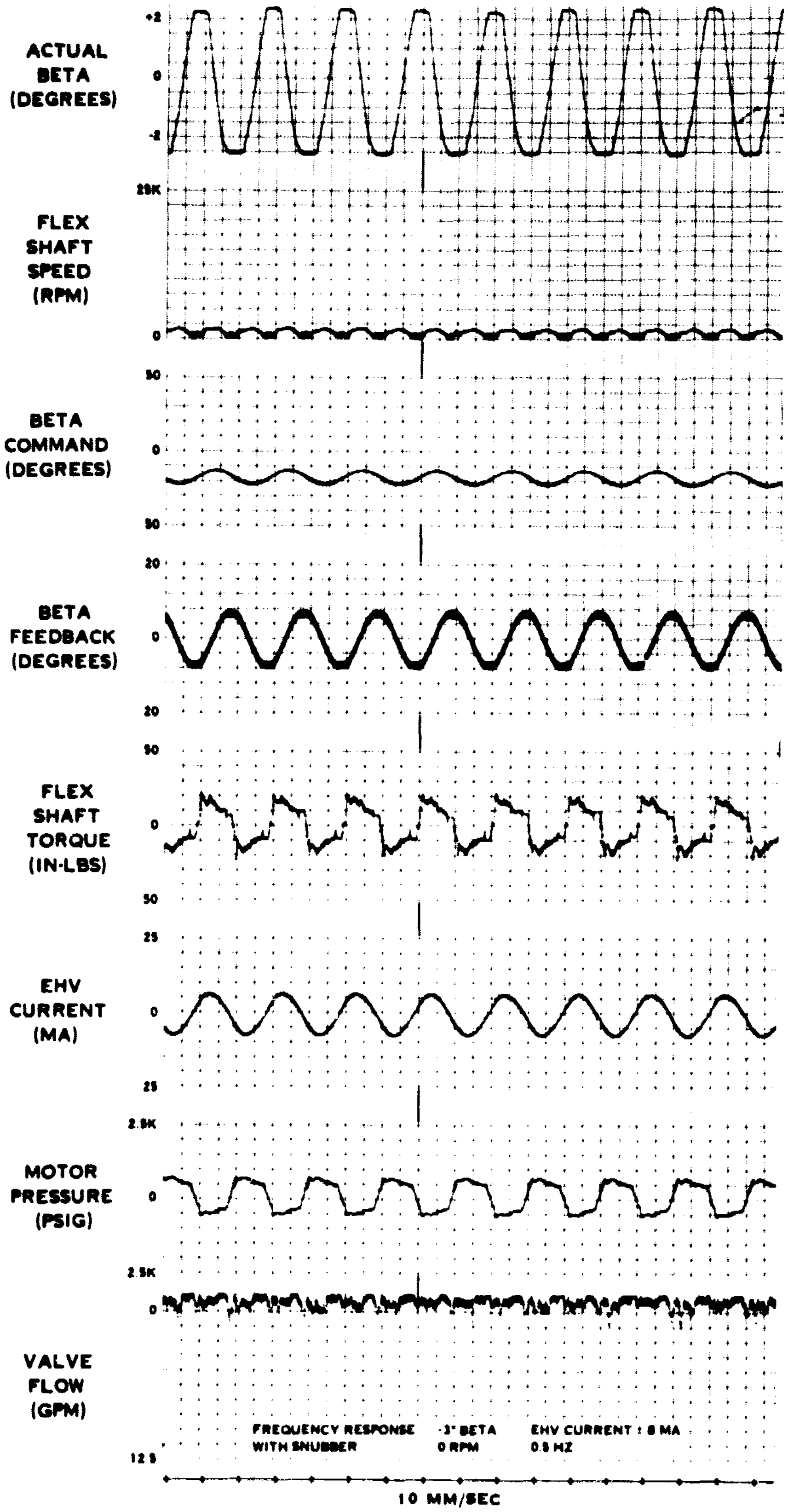

ACTUAL BETA (DEGREES)
+2
0
-2
25K
FLEX SHAFT SPEED (RPM)
0
50
BETA COMMAND (DEGREES)
0
50
20
BETA FEEDBACK (DEGREES)
0
20
50
FLEX SHAFT TORQUE (IN-LBS)
0
50
25
EHV CURRENT (MA)
0
25
2.5K
MOTOR PRESSURE (PSIG)
0
2.5K
0
VALVE FLOW (GPM)
12.5
FREQUENCY RESPONSE WITH SNUBBER
-3° BETA 0 RPM
EHV CURRENT ±4 MA 0.5 HZ
10 MM/SEC

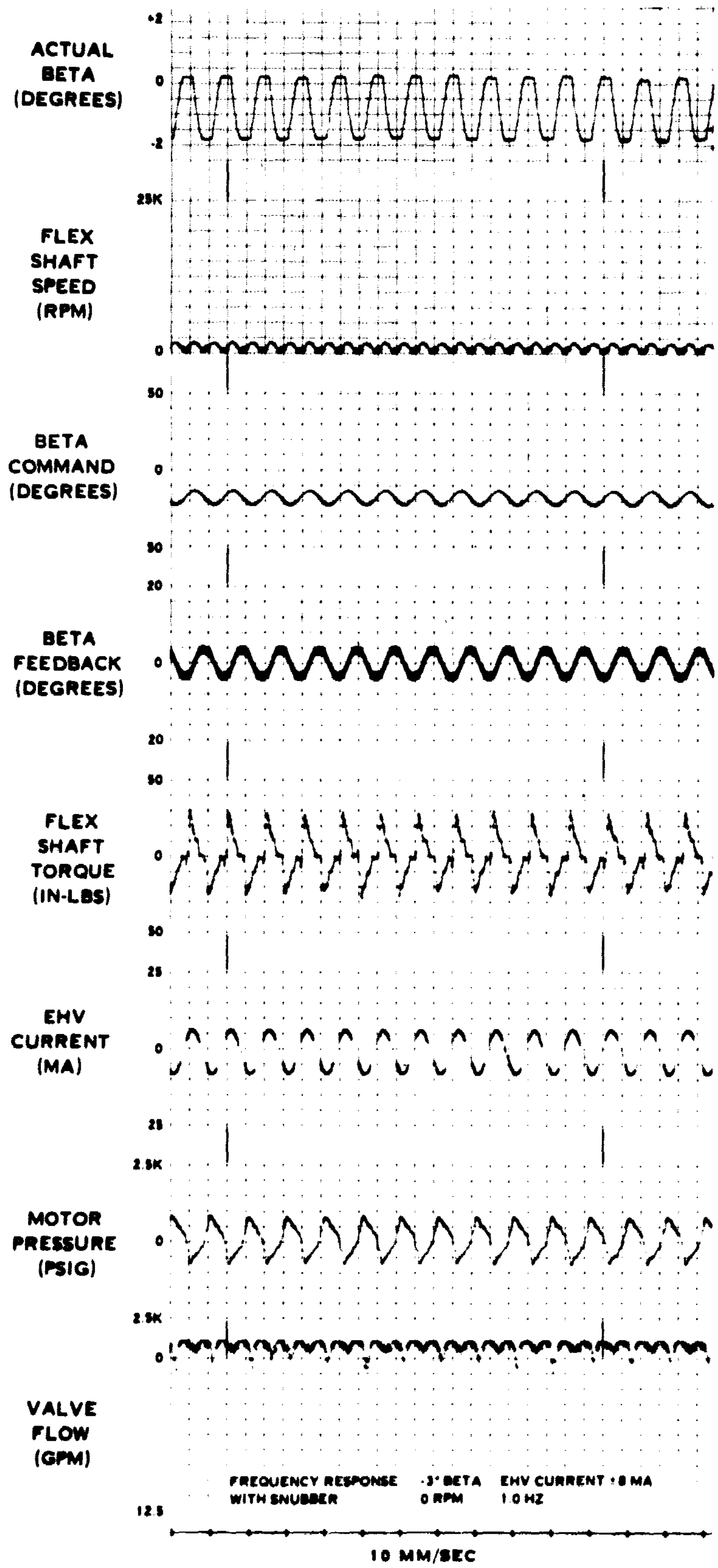


ACTUAL BETA (DEGREES)
+2
0
-2
25K
FLEX SHAFT SPEED (RPM)
0
50
BETA COMMAND (DEGREES)
0
50
20
BETA FEEDBACK (DEGREES)
0
20
50
FLEX SHAFT TORQUE (IN-LBS)
0
50
25
EHV CURRENT (MA)
0
25
2.5K
MOTOR PRESSURE (PSIG)
0
2.5K
0
VALVE FLOW (GPM)
12.5
FREQUENCY RESPONSE WITH SNUBBER
-3° BETA 0 RPM
EHV CURRENT ±4 MA 1.0 HZ
10 MM/SEC

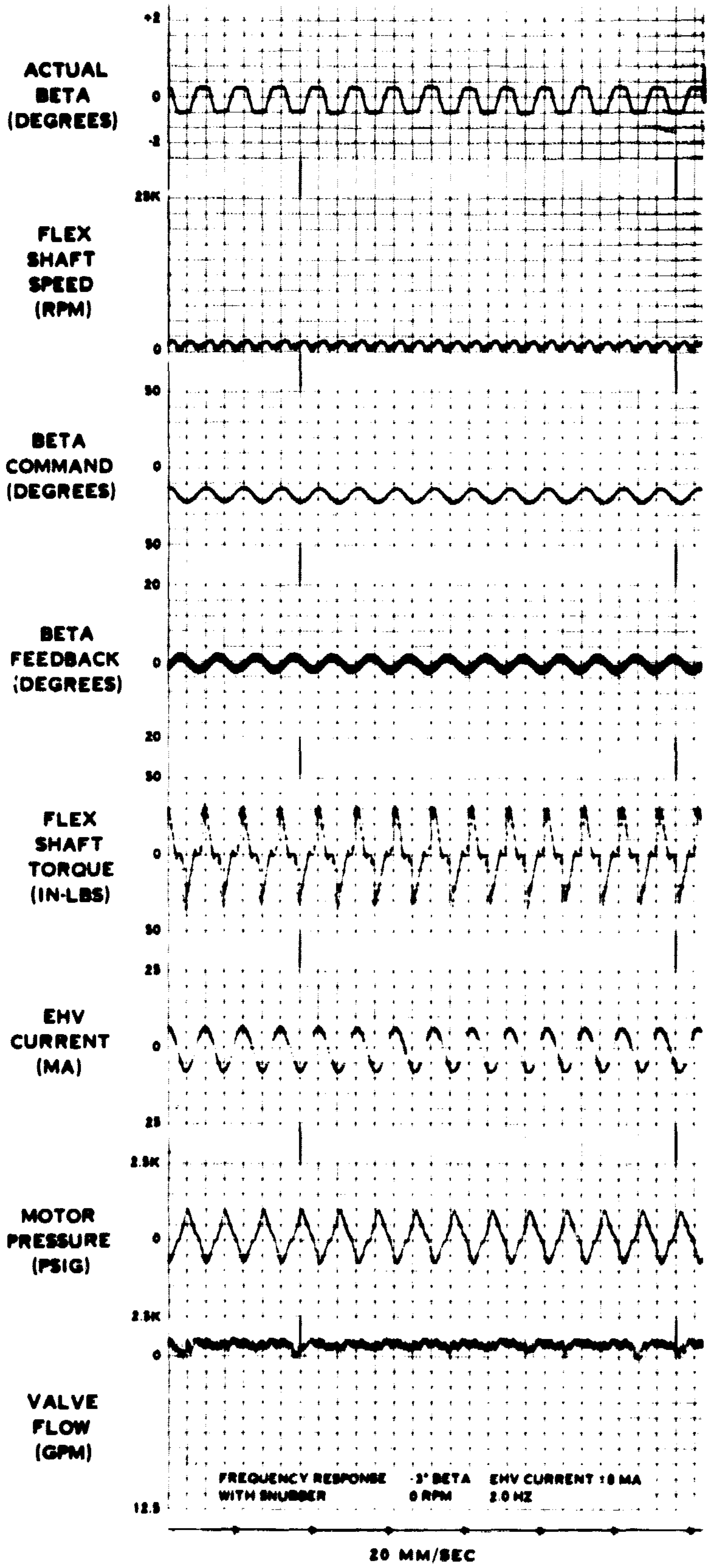

ACTUAL
BETA
(DEGREES)
+2
0
-2
25K
FLEX
SHAFT
SPEED
(RPM)
0
50
BETA
COMMAND
(DEGREES)
0
50
20
BETA
FEEDBACK
(DEGREES)
0
20
50
FLEX
SHAFT
TORQUE
(IN-LBS)
0
50
25
EHV
CURRENT
(MA)
0
25
2.5K
MOTOR
PRESSURE
(PSIG)
0
2.5K
0
VALVE
FLOW
(GPM)
12.5
FREQUENCY RESPONSE
WITH SNUBBER
-3° BETA
0 RPM
EHV CURRENT ±4 MA
2.0 HZ
20 MM/SEC

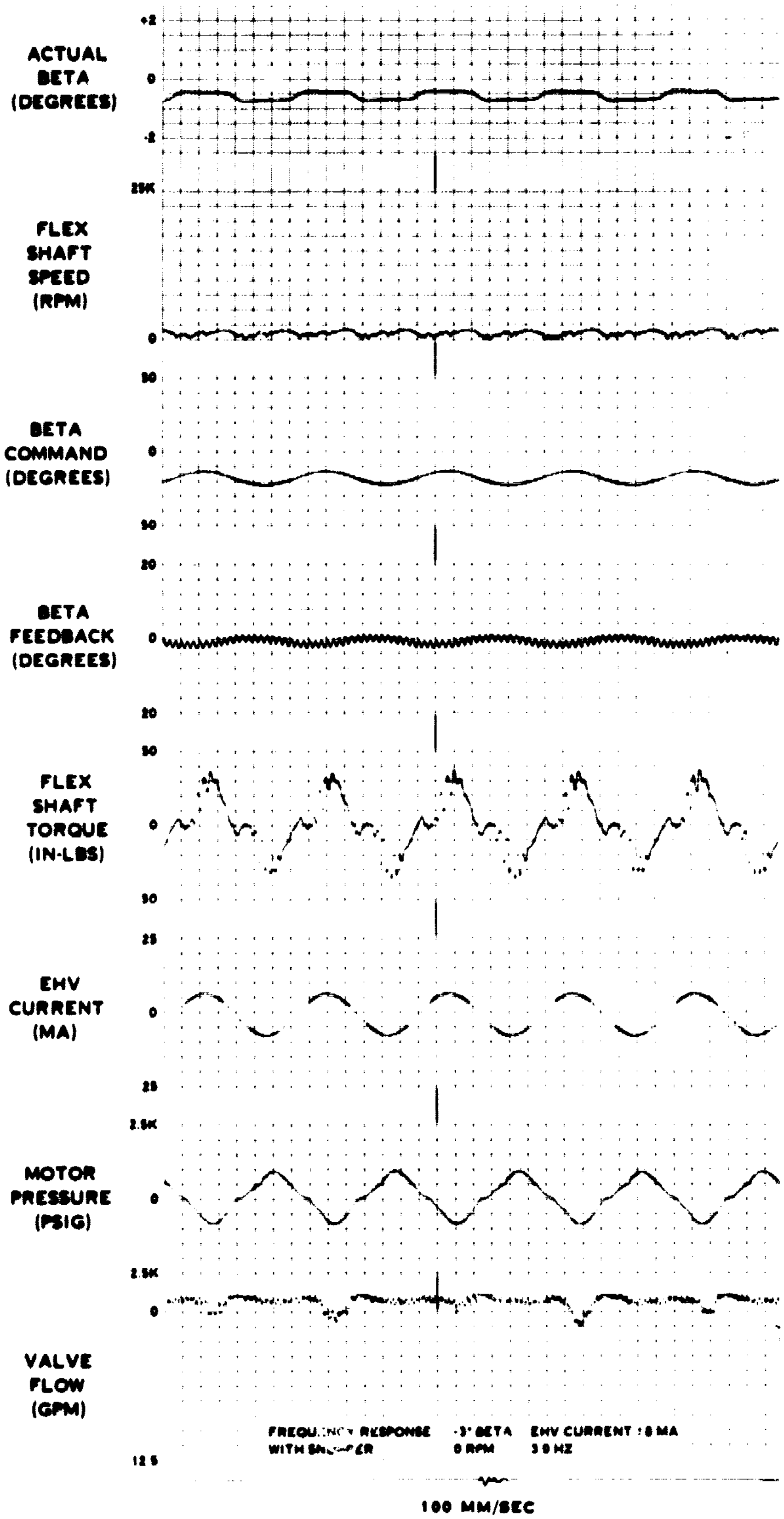

+2
FAN SPEED (RPM)
0
-2
25K
FLEX SHAFT SPEED (RPM)
0
50
BETA COMMAND (DEGREES)
0
50
20
BETA FEEDBACK (DEGREES)
0
20
50
FLEX SHAFT TORQUE (IN-LBS)
0
50
25
EHV CURRENT (MA)
0
25
2.5K
MOTOR PRESSURE (PSIG)
0
2.5K
0
VALVE FLOW (GPM)
12.5
FREQUENCY RESPONSE WITH SNUBBER
-3° BETA
0 RPM
EHV CURRENT ±4 MA
3.0 HZ
100 MM/SEC

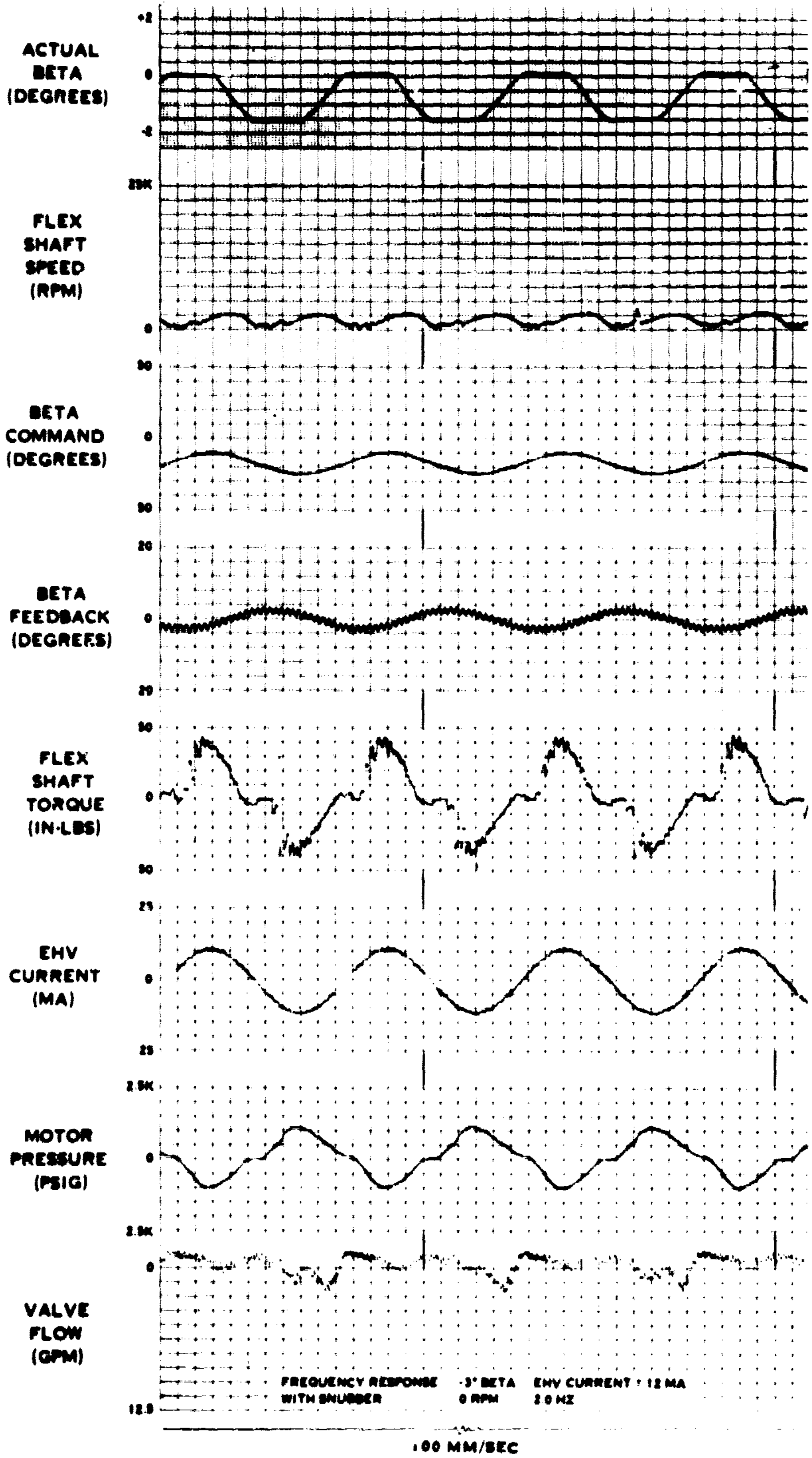

ACTUAL BETA (DEGREES)
+2
0
-2
FLEX SHAFT SPEED (RPM)
25K
0
BETA COMMAND (DEGREES)
50
0
50
BETA FEEDBACK (DEGREES)
20
0
20
FLEX SHAFT TORQUE (IN-LBS)
50
0
50
EHV CURRENT (MA)
25
0
25
MOTOR PRESSURE (PSIG)
2.5K
0
2.5K
VALVE FLOW (GPM)
0
12.5
FREQUENCY RESPONSE WITH SNUBBER
-3° BETA 0 RPM
EHV CURRENT ± 8 MA 0.5 HZ
10 MM/SEC

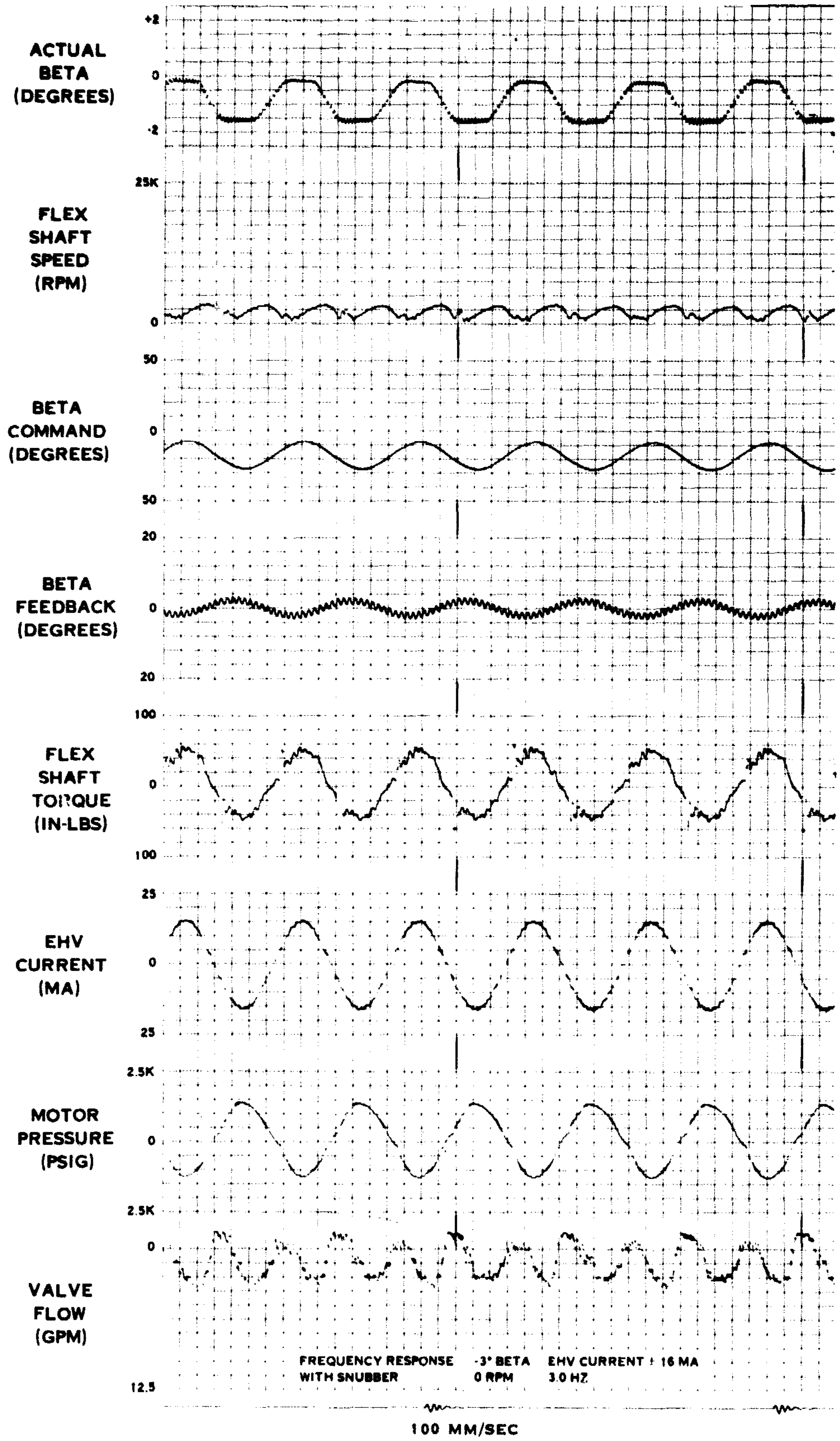


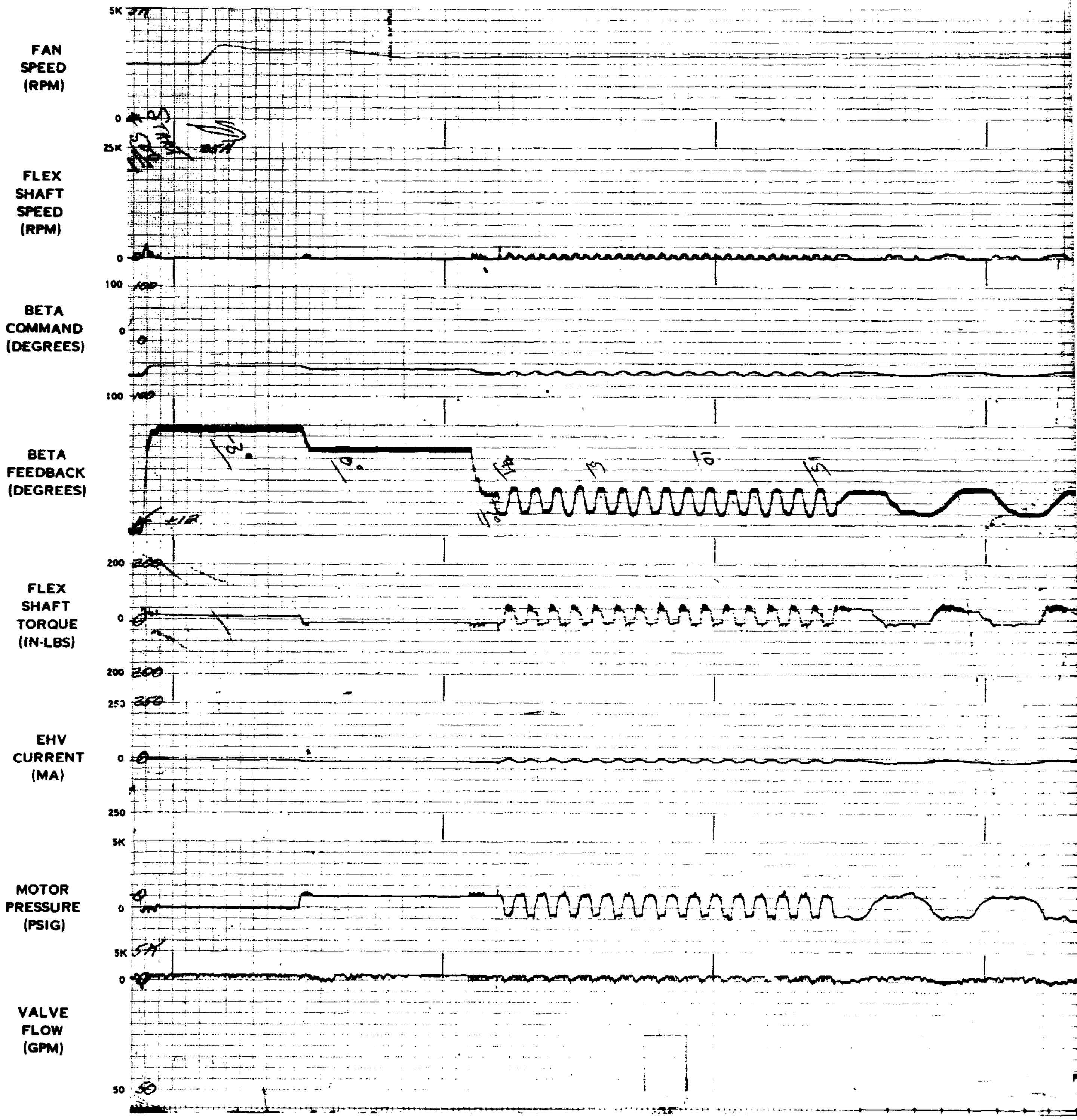
ACTUAL BETA (DEGREES)
+2
0
-2
FLEX SHAFT SPEED (RPM)
25K
0
BETA COMMAND (DEGREES)
50
0
50
BETA FEEDBACK (DEGREES)
20
0
20
FLEX SHAFT TORQUE (IN-LBS)
50
0
50
EHV CURRENT (MA)
25
0
25
MOTOR PRESSURE (PSIG)
2.5K
0
2.5K
VALVE FLOW (GPM)
0
12.5
FREQUENCY RESPONSE WITH SNUBBER
-3° BETA 0 RPM
EHV CURRENT ±8 MA 1.0 HZ
10 MM/SEC


ACTUAL BETA (DEGREES)
+2
0
-2
25K
FLEX SHAFT SPEED (RPM)
0
50
BETA COMMAND (DEGREES)
0
50
20
BETA FEEDBACK (DEGREES)
0
20
50
FLEX SHAFT TORQUE (IN-LBS)
0
50
25
EHV CURRENT (MA)
0
25
2.5K
MOTOR PRESSURE (PSIG)
0
2.5K
0
VALVE FLOW (GPM)
12.5
FREQUENCY RESPONSE WITH SNUBBER
-3° BETA 0 RPM
EHV CURRENT 10 MA 2.0 HZ
20 MM/SEC


ACTUAL BETA (DEGREES)
+2
0
-2
25K
FLEX SHAFT SPEED (RPM)
0
50
BETA COMMAND (DEGREES)
0
50
20
BETA FEEDBACK (DEGREES)
0
20
50
FLEX SHAFT TORQUE (IN-LBS)
0
50
25
EHV CURRENT (MA)
0
25
2.5K
MOTOR PRESSURE (PSIG)
0
2.5K
0
VALVE FLOW (GPM)
12.5
FREQUENCY RESPONSE
EHV CURRENT
0 RPM
100 MM/SEC


ACTUAL BETA (DEGREES)
+2
0
-2
25K
FLEX SHAFT SPEED (RPM)
0
50
BETA COMMAND (DEGREES)
0
50
20
BETA FEEDBACK (DEGREES)
0
20
50
FLEX SHAFT TORQUE (IN-LBS)
0
50
25
EHV CURRENT (MA)
0
25
2.5K
MOTOR PRESSURE (PSIG)
0
2.5K
0
VALVE FLOW (GPM)
12.5
FREQUENCY RESPONSE WITH SNUBBER
-3° BETA
0 RPM
EHV CURRENT ± 12 MA
2.0 HZ
100 MM/SEC


ACTUAL BETA (DEGREES)
+2
0
-2
25K
FLEX SHAFT SPEED (RPM)
0
50
BETA COMMAND (DEGREES)
0
50
20
BETA FEEDBACK (DEGREES)
0
20
100
FLEX SHAFT TORQUE (IN-LBS)
0
100
25
EHV CURRENT (MA)
0
25
2.5K
MOTOR PRESSURE (PSIG)
0
2.5K
0
VALVE FLOW (GPM)
12.5
FREQUENCY RESPONSE WITH SNUBBER
-3° BETA 0 RPM
EHV CURRENT ± 16 MA 3.0 HZ
100 MM/SEC



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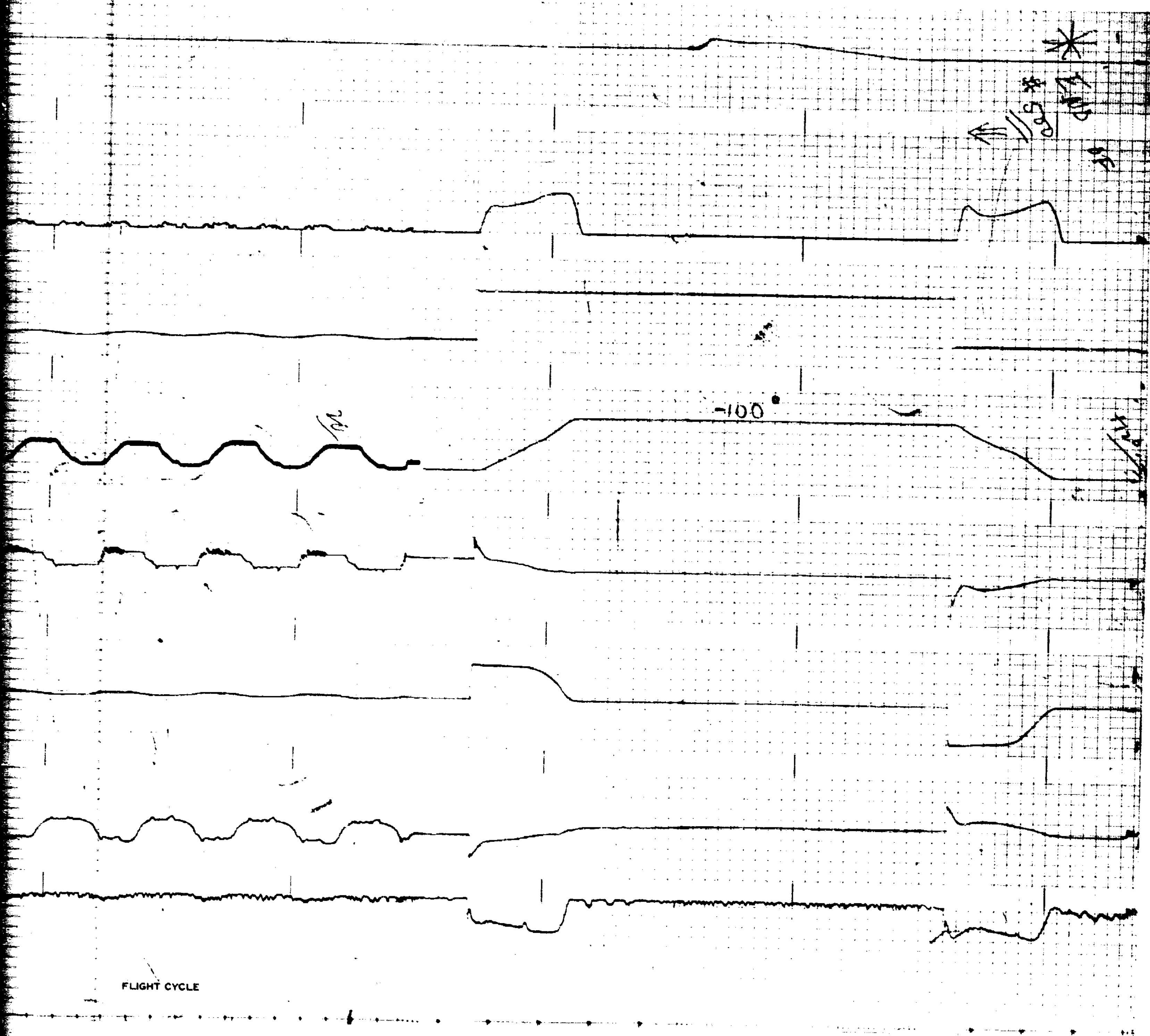
2 MM/SEC

/ FOLDOUT FRAME



20 MM/SEC 2 MM/SEC 20 MM/SEC

2 FOLDOUT FRAME

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APPENDIX D

LOG SHEETS

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Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION
WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET [illegible] OF [illegible]

E.O NO. [illegible]
TYPE OF TEST [illegible]
W.P.I. NO. [illegible]
PLAN OF TEST NO. HS 6971 [illegible]
SERIAL NO. 1
PART NO.
DATE [illegible]
ENGINEER [illegible]
OPERATORS [illegible]

UNITS →	—	psig	—	in³/min	gal/min	°F	
TIME	Pin	Pout	ΔP	Flow	Flow	Tin	
0900	[illegible]	0	[illegible]	8	2	110	"OPEN VALVE [illegible]"
	3000	35	[illegible]	20	5	111	
	3000	25	2975	40	10	113	
	3000	25	3035	60	15	145	
	3035	30	3005	75	18.75	147	
	3010	30	3030	60	15	147	
	3010	30	2980	40	10	147	
	3010	30	2980	20	5	147	
	3000	0	2990	—	0	150	VALVE CLOSED
	3000	0	3000	—	—	135	LEAKAGE = 2 cc/min

Rev'd
H. Kaman
9-18-75

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REMARKS:

REPORT NO.
HSER 7002

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WINDSOR LOCKS, CONNECTICUT • U.S.A.

A.

ENGINEERING LABORATORIES

RIG NO. 2
TYPE OF TEST: MANIFOLD FUNCTIONAL
W.P.I. NO. [illegible]
PLAN OF TEST NO. HS(971 FIG. 5
SERIAL NO. 1
PART NO.
DATE
ENGINEER
OPERATORS

TIME	Pin	Pout	ΔP	Flow	Flow	Tin	
0930	[illegible]	0	[illegible]	16	4	149	"CLOSE VALVE CHANGED"
	3010	10	3000	20	5	151	
	3040	20	3040	40	10	152	
	[illegible]	30	3130	60	15	153	
	[illegible]	35	3125	73	15.25	154	
	[illegible]	35	[illegible]	60	15	156	
	[illegible]	35	[illegible]	40	10	157	
	[illegible]	[illegible]	[illegible]	20	5	158	
	3175	0	3175	—	—	159	VALVE CLOSED
	3000	0	3000	—	—	155	LEAKAGE = 1.5 cc/min

REMARKS.

REPORT NO.
HSER 7002

HSF 1758 4/67

Hamilton Standard DIVISION OF UNITED AIRCRAFT CORPORATION U A
WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET 1 OF

RIG NO. G-7
TYPE OF TEST
W.P.I. NO. 109-002-003A
PLAN OF TEST NO.
SERIAL NO.
PART NO.

DATE 10-30-75
ENGINEER P. Smith
OPERATORS E. Schwartz

TIME	RPM	G-Box Lube Press	Vibration Vert	Vibration Horz	
	500	20	0	0	
	1000	20	0	0	
	1500	20	0	0	
	2000	20	0	0	
	2500	20	.1	.1	
	3000	20	.2	.1	WITH BOLT ADDED
	3000	20	.1	.1	WITHOUT BOLT

REMARKS:

REPORT NO. HSER 7002

HSF 1758 4/67

Hamilton Standard
DIVISION OF UNITED AIRCRAFT CORPORATION
WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET 1 OF

RIG NO. [illegible]
TYPE OF TEST LVDT Calibration (Para 4.2)
W.P.I. NO. [illegible]
PLAN OF TEST NO. [illegible] TT-31 Rev A
SERIAL NO. 1
PART NO. [illegible] (Ref)
DATE [illegible]
ENGINEER D. [illegible]
OPERATORS

UNITS → TIME		[illegible]	CCW Angle	Blade Angle	LVDT #1 Volts	LVDT #2 Volts	LVDT EXC Volts				LVDT EXC Freq					
		0	42.2	[illegible]	2.3714	2.3712	5.666	IP 4.2.2			(400 Hz)					
		18	35.0	10	2.117	2.105	5.665									
		31	30.0	5	1.901	1.905	5.667									
		43.5	25	0	1.715	1.711	5.664									
		[illegible]	20	5	1.517	1.509	5.666									
		64.5	17	8	1.402	1.397	5.667	Set electrical stop								
		71	15	10	1.307	1.305	5.667									
		85	10	15	1.094	1.091	5.665									
		100	5	20	.813	.810	5.666									
		113	0	25	.706	.704	5.665									
		126	-5	30	.518	.517	5.665									
		138	-10	35	.345	.342	5.666									
		149	-15	40	.184	.183	5.665									
		160	-20	45	.033	.033	5.664									
		171	-25	50	-.121	-.121	5.665									
		181	-30	55	-.265	-.265	5.665									

REMARKS:

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WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET 2 OF [illegible]

DATE [illegible]

ENGINEER [illegible]

OPERATORS

RIG NO. C-2

TYPE OF TEST [illegible]

W.P.I. NO. [illegible]

PLAN OF TEST NO. 232 PT-31 [illegible]

SERIAL NO. 1

PART NO. [illegible]

UNITS →		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]									
TIME		[illegible]	[illegible]	[illegible]	[illegible] VOLTS	[illegible] VOLTS	[illegible] VOLTS	[illegible]									
		191	-35	[illegible]	.435	.1125	5.665										
		[illegible]	-40	65	.575	.571	5.665										
		[illegible]	-45	70	.725	.735	5.665										
		[illegible]	-50	75	.875	.873	5.665										
		[illegible]	-55	80	1.027	1.027	5.665										
		243	-60	85	1.190	1.187	5.665										
		[illegible]	-65	90	1.353	1.351	5.665										
		[illegible]	-70	95	1.520	1.514	5.665		Set electrical stop								
		[illegible]	-75	100	[illegible]	1.683	5.665										
		[illegible]	-80	105	1.850	1.847	5.665										
		[illegible]	-85	[illegible]	2.007	2.003	5.665										
		[illegible]	-90	115	2.163	2.160	5.665										
		[illegible]	-95	[illegible]	2.210	2.184	5.665										
		[illegible]	97.7	133.7	[illegible]	2.378	5.665										

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REMARKS:

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 3 OF ___

P.G NO. [illegible]

TYPE OF TEST [illegible] check

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222 PT-31 - Rev A

SERIAL NO. 1

PART NO. 76[illegible]500-1

DATE 11 [illegible] 75

ENGINEER Nelson

OPERATORS [illegible]

UNITS →		[illegible]	Covers	[illegible]	Time	Flow
TIME		[illegible]	initial	[illegible]	[illegible]	Meter
		110				
		Leak out vent hole - Plugged vent hole [illegible]				
		Between covers				
		120	20	30	21.2	—
		120	20	[illegible]	11.4	—
		80	20	30	22.8	174
		120	20	[illegible]	20.5	199

REMARKS: Unable To regulate Press with Press Relief valve in line, used Press regulator on Pump - Lube Press. reading on 0-200 PSI gauge.

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 1 OF

DATE 11-20-[illegible]
ENGINEER [illegible]
OPERATORS [illegible]

LOG NO. G-7
TYPE OF TEST [illegible] (V.[illegible])
W.P.I. NO [illegible]-C03-AC0A
PLAN OF TEST NO. 222 PT-31 Rev A
SERIAL NO.
PART NO. [illegible]

UNITS → / TIME	Total Time	Total Time		Fan RPM	EHV Inlet PSI	#1 Beta Reg PSI	#2 Beta Reg PSI	Flex Shaft RPM	Act Beta Angle	Stop Blade Angle	Act Inlet PSI	Act [illegible]	#3 [illegible]	Gear #4 Act Lube	#5 Amb [illegible]	#6 [illegible]
[illegible]	0	0		2000	2000	400	—				100	[illegible]	125	120	141	134°
[illegible]	0[illegible]	0[illegible]	[illegible] leaking very badly.													
		Stopped to clean cell etc.														
[illegible]	[illegible]	[illegible]		[illegible]												
[illegible]	0[illegible]	[illegible]		Shut Down -												
[illegible]		[illegible]		2000							98		110°	132°	156°	135°
[illegible]	[illegible]	[illegible]		Shut Down - water [illegible] -												

REMARKS: Mil 7808 Hyd oil
[illegible] 4.3

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. C-7
TYPE OF TEST [illegible] (Para 4.3)
W.P.I. NO. [illegible]
PLAN OF TEST NO. 222PT [illegible] Rev A
SERIAL NO.
PART NO. [illegible]
SHEET 1 OF
DATE [illegible]
ENGINEER [illegible]
OPERATORS [illegible]

130

UNITS → TIME	Test Time	Total Time		Fan RPM	EHV Inlet PSI	Beta [illegible] PSI	Beta [illegible] PSI	Flex [illegible] RPM	Act [illegible] Angle	Stop Blade Angle	Act [illegible] PSI	Act [illegible]	[illegible] EHV [illegible]	[illegible]	[illegible] Amb Temp	[illegible] Temp
				0	1160	—	—	5000	93	95.2						
				0	1160	—	—	7500	-8	-8.1						
				0	1800	—	—	10000	-8	-8.1						
				0	1800	—	—	10000	95	95.5						
				0	2100			11000	95	95.5						

Actuator Locked Up - Cannot Turn From Input Shaft

REMARKS: Mil [illegible]

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. G-7
TYPE OF TEST [illegible] 4.3
W.P.I. NO. [illegible] 002-A0 A
PLAN OF TEST NO. 222PT-31 Rev A
SERIAL NO.
PART NO. [illegible] 300-1
SHEET 2 OF
DATE 11-6-75
ENGINEER D. [illegible]
OPERATORS [illegible]

UNITS → TIME	Test Time	Total Time		Prop RPM	HV Inlet PSI	Beta Res PSI	Beta Res PSI	Max Shaft RPM	Act Blade Angle	[illegible] Blade Angle	Act Lube Flow	Act Lube PSI	[illegible]	Act [illegible]	[illegible]	[illegible]
[illegible]	0	0 23		2311	---	---	—	---	34.2		138	171				
[illegible]	0	0 21														112.4°
[illegible]	0	0	Lost Power			Cut	Out		on		overload	Lamp.				
1605		0 21		2500					6.0						160	
1430		26														
		26														
1115				2500	—	—	—	—	6.0					89	114	114
1135		0 11														

REMARKS: Mil 7808 Hyd. oil

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 1 OF ___

DATE 11-21-75

ENGINEER D. Smith

OPERATORS [illegible] / Hunt

132 RIG NO. G-7 G.E QCSEE ACTUATOR

TYPE OF TEST FUNCTIONAL TEST

PLAN OF TEST NO. 222PT-31 Rev N

W.P.I. NO. 109-C33-A02B

SERIAL NO.

PART NO. 763550

	UNITS →	TEST	TOTAL		RIG	LPS	PSIG	PSIG	PSIG		#1 °F	#2 °F	#4 °F	#5 °F	MILS	MILS	DEG.
	TIME	TIME	TIME		RPM	LUBE OIL FLOW	LUBE OIL	EHV [illegible]	GB OIL		CLUTCH	EHV [illegible]	LUBE OIL	CELL TEMP.	HORIZ	VERT	PHASE °.
1st Hr	Start 2205		0 41		2500	182	100	1900	18 ~~16~~		113	81	101	112	-	.4	13.87
2nd Hr	2215	0 10	0 51		2000	220	100	2150 ~~18~~	18 ~~16~~		113	102	120	90	-	.3	11.33
3rd Hr	2219	0 14	0 55		2500	225	100	2150	18		114	108	124	115	-		
	Stop 2220		0 56	MAIN DRIVE MOTOR STOPPED ON OVERLOAD													
	Start 2245		0 56		2500	200	100	2150	18		116	121	109	112	-	.4	9.87
	Stop 2250		1 01	MAIN DRIVE MOTOR KICKED OUT ON OVERLOAD @ 2744 RPM													
				11-22-75 J. HINSKY													
	Start 1010	0 02	1 01		2300												
	Stop 1012	0 02	1 03	AUTO SHUT CLUTCH TEMP.													
	Start 1015	0 00			2500	170	100	—	18								
	Stop 1017	0 02	1 05	MAIN - MAIN POWER DROPPED OUT													
	Start 1101	0 00			2500	177	100	—	16.5		117	79	94	77	.9	.4	-
	Stop 1108	0 07	1 12	SHUT DOWN FOR [illegible] TO MANUALLY RESET BLADE #													
	Start 1235	0 00			2510	198	100	2150	17.0		132	26	26				
	Stop 1238	0 03	1 15	MAIN - MAIN POWER DROPPED OUT.													

REMARKS:

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 2 OF ___
DATE 11.25.75
ENGINEER D. [illegible]
OPERATORS J. [illegible]

RIG NO. G-7
TYPE OF TEST G.E. [illegible] ACTUATOR FUNCTIONAL TEST
PLAN OF TEST NO. 222PT-31 Rev. H
W.P.I. NO. 109-C07-402B
SERIAL NO.
PART NO. 763500

UNITS → / TIME	TEST TIME	TOTAL TIME		RIG RPM	CPS LUBE OIL FLOW	PSIG LUBE OIL	PSIG EHV SUPPLY	PSIG GB OIL		#1 °F CLUTCH	#3 °F EHV SUPPLY	#4 °F LUBE OIL	°F COIL HSG.	MILS VIB. VERT	MILS VIB HORZ	DEG. PEDAL ∠
START 1214	0 .58	1 15		2450												-3.?
STOP 1216	0 .02	1 17			MAIN-	MAIN	POWER	DRIVEN		OUT.		HAD	BREAKER	RESET		
					11-24-75								Operator J. Forecki			
Start 1515	0	1 12		2500	141.2	100	2000	19.5		128°	69	78°	73°	3.8	5.4	-112.97
1522				3401	154.1	100	2000	19.5		116°	~~73°~~ 83°	92°	91°	0.3	0.3	-112.97
1525				3578	165	100	2000	19.5						0.4	0.45	-112.97
Stop 1526	0 11	1 23	Lost Power. End of Noise Survey													
						11-25-75					Operator J. Forecki					
Start 1442	0	1 28		3012	119	100	~~3017~~ 2000	19.5		116°	75°	54°	112°	0.3	0.3	-106
Stop 1450	0 .08	1 36	Lost Speed Panel light stayed on.													
Start 1500	0	1 36		3590	197	100	200	19		117°	99°	104°	114°	0.4	0.4	-07.6
1505	0 .05	1 41	Lost Power													

REMARKS:

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 3 OF

RIG NO. G-7
TYPE OF TEST GE QCSEE Adjuster Functional Test
W.P.I. NO. 783-C05-140F B
PLAN OF TEST NO. 222PT-31 Rev A
SERIAL NO.
PART NO. 762576
DATE 11-26-
ENGINEER
OPERATORS

UNITS →	Desi	Total		Rig	CPS	PSIG	PSIG	PSIG		°F	°F	°F	°F	Mils	Mils	Deg
TIME	Time	Time		RPM		Lube oil	EHV Supply	GB oil		Clutch	EHV Supply	Lube oil	Cell Amb	Vib Vert	Vib Horz	
2115		1 48		2700		100	2000	18		108	64.5					
		1		stop												
2145		1		2700	150	100	2000	18		101	66	78	69	.3	.4	5.87
2155		1 56		3100	169	100	2000	18		102	69	87	91	.2	.4	5.35
2156		1 57		3100		100	2000	18		92	80	87	103	.2	.4	2.3
2200		2 01		3670	172	100	2000	18		90	89	91	107	.3	.4	8.47
	Unable To change Blade X to open Brought up Servo Press To 2300 PSIG.															
2205		2 06		3070	186	100	2300	18		87	112	97	110	.3	.4	10.57
	Still unable to change blade X to open, raised pressure to 2700 PSIG															

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REMARKS:

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. [illegible]

TYPE OF TEST [illegible] Functional Test

W.P.I. NO. [illegible]-003-A02 [illegible]

PLAN OF TEST NO. 222PT-31 Rev A

SERIAL NO.

PART NO. 76 [illegible]

DATE 11-[illegible]-75

SHEET 4 OF

ENGINEER [illegible]

OPERATORS [illegible]

TIME	Test Time	Total Test Time		Rig RPM	LPS Lube Flow	PSIG Lube Oil	PSIG EHV Supply	PSIG GB Oil	°F Shroud Temp	#1 °F Outlet	°F [illegible]	°F [illegible] Oil	[illegible]	Mils Vib. Vert.	Mils Vib. Horiz.	[illegible]
[illegible]	0	2 16		2703	127.3	100	3400	19	73°	99°	77	74		0.3	0.4	[illegible]
1000	0 13	2 31		3070	202	100	3400	18	114°	98°	150°	110°		0.2	0.3	+9
[illegible]	0 2[illegible]	2 36		3410	218.9	100	3375	18	124°	96°	165°	120°		0.2	0.2	+00.6
[illegible]	0 2[illegible]	2 33	Stopped to inspect Prop, lines etc. Repaired leak at flex hose tube.													
[illegible]	0	2 35		2104	220	100	3375	19	54°	104°	153°	117°		0.3	0.4	+12
[illegible]				3409	223	100	3375	19	~~102~~ 75	94°	157°	123°		0.3	0.4	.00[illegible]
1105	0 5	2 43		3068	225	106	3375	18	112°	93°	160°	123°		0.2	0.3	+00.[illegible]
[illegible]	0 12	2 35		2703												
[illegible]	0	2 55		3572	236	106	—	18	111°	94°	132°	134°		0.2	0.2	-00.[illegible]
[illegible]	0 24	2 59														
[illegible]	0	2 59		3411	236	100	—	18	116°	105°	125°	133°		0.1	0.1	02.31
[illegible]	0 [illegible]	3 02		3315	225	100	2000	19	103°	101°	144°	123°		0.2	0.2	02.11
[illegible]	0 [illegible]	3 02		2702	229	100	3406	18	120°	96°	158°	126°		0.2	0.2	00.39
[illegible]	0 10	3 [illegible]														
1110	0	3 [illegible]														
[illegible]	0	3 22	Set Pots to Vary Speed at 2700, 3068 & 3405 RPM													
1422	0	3 32	Stopped Engineer checking results on [illegible]													

REMARKS [illegible] on Flexhill [illegible]

*[illegible]

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LOG OF TEST
ENGINEERING LABORATORIES

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RIG NO. G-7
TYPE OF TEST GE QCSEE Actuator Functional Test
W.P.I. NO. T09-C03-A02B
PLAN OF TEST NO. 222PT-31 Rev A
SERIAL NO.
PART NO. [illegible]

SHEET 5 OF
DATE 11-24-[illegible]
ENGINEER [illegible]
OPERATORS [illegible]

TIME	Test Time	Test Time	PAA	Rig RPM	CPS Lube Flow	PSIG Lube Oil	PSIG EHV Supply	PSIG GB Oil		°F Clutch	°F EHV Supply	°F Lube Oil	°F [illegible]	Mils Vib Vert	Mils Vib Horiz	Deg Blade [illegible]
Start 1512	0	3^{32}		3313	219	100	3400	19		102°	146	117°	102°	0.2	0.3	[illegible]
Stop 1517	0^{02}	3^{34}	Stopped	Replaced #1 EHV Pump 200	[illegible] with #2 EHV Pump											
Start 1727	"	3^{34}		3300	156	102	3600	19		101°	69°	67°	81°	.3	.3	-3°
1731	"	3^{38}		3317	158	100	4000	17.5		93°	135	98	102	.2	.3	-3°
Stop 1738	"	[illegible]	[illegible] Down - #2 Pump [illegible] - [illegible]													-
				Moved Plug -												
Start 1050	"	3^{55}		3318	161	100	3580	17.5		102°	67°	66°	88°	.2	.4	-3°
Stop 1100	"	4^{05}	[illegible] Down - Check Blade Angle													
			45.4	Min Angle Chk Static -0.1°												
					Close - Min Chg -0.3 [illegible] .2° Change [illegible]											
					Open -0.1 [illegible] .2° Change											
Start 1139	"	4^{05}		3300	160	100	2150	19.0		103°	107°	140	130	.2	.3	30°
1135	"	4^{11}	Start Cycle #1													
1140	"	4^{16}		3067	198	100	3220	17.5		93°	136°	106°	106°	.2	.4	+7°
Stop 1149	"	4^{25}	[illegible] Down - [illegible] Temp													
203[illegible]	"	4^{25}		3266	155	100	2000	18.2		98°	83°	86°	86°	.2	.4	

REMARKS: Recording data on Hewlett Packard Recorder.

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 6 OF ___
DATE [illegible]
ENGINEER D. [illegible]
OPERATORS [illegible]

RIG NO. C-1
TYPE OF TEST [illegible] PLAN OF TEST NO. ___
W.P.I. NO. [illegible] SERIAL NO. ___ PART NO. [illegible]

UNITS →	[illegible]	[illegible]		Rig	CPS	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TIME	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	20	4:35		Shut down - [illegible] back [illegible] pump												
2100	20	4:35		3068	145	100	2800	18.0		109°	92°	74°	75°	.3	.4	+5°
2130	30	4:55		3105	201	110	2800 3100	17.5		76°	120°	118°	123°	.3	.4	+12°
2143	43	4:58		Start of 2nd flight cycle												
2135	35	5:10		End of 2nd flight cycle - Start of 3rd cycle												
2145	45	5:20		End of 3rd flight cycle - Start of 4th cycle												
2155	55	5:30		End of 4th flight cycle - Start of 5th cycle												
2156	56	5:32		3105	210	100	3040	17.0		94°	119°	112°	109°	.2	.4	0°
2158	58	5:33		3056	211	100	3040	17.0		94°	137°	113°	111°	.2	.4	5/70°
2205	105	5:40		End of 5th flight cycle												
2206	106	5:41		Shut down - checked unit - okay - [illegible]												
2216	[illegible]	5:41		2700	166	100	3120	17.5		105°	72°	73°	78°	.3	.4	+12°
[illegible]	07	5:48		Start of 6 flight cycle -												
2232	09	5:50		3065	191	100	3120	17.0		97°	128°	123°	121°	.2	.4	45/70°
[illegible]	15	5:56		Finished 6th flight cycle - start 7th cycle												
2215	16	5:56		3068	199	100	3120	17.0		96°	113°	126°	108°	.2	.4	45/70°

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. C-1 SHEET 2 OF

TYPE OF TEST [illegible] Fuel Simul. Test DATE [illegible]

W.P.I. NO. [illegible] -C3-A-2B PLAN OF TEST NO. ENGINEER [illegible]

SERIAL NO. PART NO. [illegible] OPERATORS [illegible]

UNITS → TIME	Test Time	Total Test Time	PAR	Rig RPM	[illegible]	[illegible]	[illegible]	[illegible]		[illegible] Clutch	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	—	6 [illegible]	COMPLETED 1st FLIGHT CYCLE - [illegible] CYCLE													
[illegible]	35	6 [illegible]		3400	204	100	3120	17.0		95°	121°	[illegible]	118°	.2	.4	-3°
[illegible]	36	6 [illegible]		3428	205	100	3120	17.0		95°	119°	[illegible]	111°	.2	.4	[illegible]
[illegible]	33	6 [illegible]	COMPLETED 8th FLIGHT CYCLE - [illegible] CYCLE													
2302	34	6 [illegible]		3667	209	100	3120	17.0		95°	123°	111°	111°	.2	.4	[illegible]
[illegible]	40	6 [illegible]	COMPLETED 9th FLIGHT CYCLE - [illegible] 10th CYCLE													
[illegible]	[illegible]	6 [illegible]		3666	211	100	3120	17.0		96°	124°	112°	110°	.2	.4	[illegible]
[illegible]	[illegible]	6 [illegible]	COMPLETED 10th FLIGHT CYCLE ~~[illegible]~~													
[illegible]	[illegible]	6 [illegible]	SHUT DOWN - [illegible] UNIT - [illegible] SUPPLY [illegible]													
2340	[illegible]	6 [illegible]		2700	172	STARTED 11th FLIGHT CYCLE										
[illegible]	[illegible]	6 [illegible]		3468	182	100	3000	17.5		103°	94	96	90	.2	.4	-3°
[illegible]	[illegible]	6 [illegible]		3468	191	100	3000	17.0		99°	98°	102°	99°	.2	.3	[illegible]
[illegible]	[illegible]	6 [illegible]	COMPLETED 11th FLIGHT CYCLE - STARTED 12th CYCLE													
[illegible]	[illegible]	6 [illegible]		3666	198	100	3000	17.0		97°	117°	105°	106°	.2	.3	[illegible]
[illegible]	[illegible]	6 [illegible]	COMPLETED 12th FLIGHT CYCLE - STARTED 13th CYCLE													
[illegible]	[illegible]	6 [illegible]		3468	200	100	2780	17.0		95°	114°	116°	107°	.2	.3	-3°

REMARKS:

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Hamilton Standard

DIVISION OF UNITED AIRCRAFT CORP.

WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. [illegible]

TYPE OF TEST [illegible]

W.P.I. NO. [illegible]

PLAN OF TEST NO. 2227T-31 [illegible] A

SERIAL NO.

PART NO. [illegible]

SHEET 5 OF

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS ► / TIME																
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		3067	202	100	3000	17.0		95°	115°	[illegible]	111°	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	COMPLETED 13TH FLIGHT CYCLE - STARTED 14TH CYCLE													
[illegible]	[illegible]	[illegible]		3005	205	100	3000	17.0		96°	115°	109°	109°	.2	.3	[illegible]
[illegible]	[illegible]	[illegible]	COMPLETED 14TH FLIGHT CYCLE - STARTED 15TH CYCLE -													
[illegible]	[illegible]	[illegible]		3[illegible]7	208	100	3130	17.0		95°	113°	109°	108°	.2	.3	0°
[illegible]	[illegible]	[illegible]		3006	207	100	3020	17.0		95°	120°	110°	110°	.2	.3	[illegible]
[illegible]	[illegible]	[illegible]	COMPLETED 15TH FLIGHT CYCLE													
[illegible]	[illegible]	[illegible]	SHUT DOWN -													
Start	*	*		11-29-75						Eng. / Operator		D Nelson / J. Koreck				
1010	0	7 13		2702	151	100	~~3100~~ 3000*	19.5		104°	73°	81°	68°	0.3	0.4	+12.37
[illegible]				Started 16th Cycle												
[illegible]	0 09	7 32		2419	174	100%	~~3100~~ 3000*	18		100°	95°	95°	105°	0.1	0.3	03.51
1020	0 11	7 33		2700	206	100	3/00	17.5		101°	115°	111°	122°	0.3	0.3	+11.77
1031	0 12	7 34	Completed 16th Flight cycle Started 17th cycle													
1035	0 16	7 38		3068	219	100	3/00	17		101°	127	120°	125°	0.2	0.2	+07.95
10[illegible]	0 15	7 46	Completed 17th Flight Cycle & Started 18th Cycle													

REMARKS: * Corrected Time on Page 9

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WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

140

RIG NO. G-7
TYPE OF TEST GE [illegible] Functional Test
W.P.I. NO. 103-C03-A03B
PLAN OF TEST NO. 22297-31, Rev A
SERIAL NO.
PART NO. [illegible]
SHEET 9 OF
DATE 11-23-75
ENGINEER D. [illegible]
OPERATORS [illegible]

UNITS ➔	Run Time		Rig RPM	ARS Lube [illegible]	Rig Lube Oil	Rig EHV [illegible]	Rig G/B Oil		[illegible] °F Clutch	[illegible]	[illegible]	[illegible] °F	Vib	Vib	Deg.
1039	0 29	7 43	3065	228	100	3100	17		101°	133°	127°	127°	0.1	0.2	02.90
1045	0 26	7 [illegible]	2700	225	100	3100	17		100°	133°	134°	116°	0.2	0.3	[illegible]
1046	0 27	7 49	Completed 18th Flight cycle & Started 19th cycle.												
1048	0 29	7 50	3061	220	100	3100	17		101°	136°	119°	111°	0.2	0.2	+05.03
1052	0 33	7 54	2703	216	100	3100	17		100°	135°	118°	111°	0.2	0.3	+11.[illegible]
1054	0 35	7 56	Completed 19th Flight cycle & Started 20th cycle												
1057	0 38	7 59	3410	217	100	3100	17		101°	123°	117	110°	0.2	0.2	+03.37
1102	0 43	[illegible]	Completed 20th Flight cycle & Shut down for inspection.												
Start 1205	0 52	[illegible]	2709	170	100	3000	18		101°	91°	90°	86°	0.2	0.3	+11.90
1207	0 54	8 01	Started 21st Flight cycle												
1213	0 59	8 12	2702	196	100	3000	17.5		103°	103°	96°	104°	0.2	0.3	+11.[illegible]
1215	1 01	8 14	Completed 21st Flight cycle & Started 22nd cycle												
1225	1 11	8 24	3063	179	100	2500	17		105°	115°	106°	108°	0.2	0.2	+05.53
1230	1 16	8 29	Completed 22nd Flight cycle & Started 23rd cycle												
1233	1 19	8 32	3067	204	100	2900	17		104°	115°	123°	111°	0.2	0.2	+04.50
			RAISED SUPPLY PRESSURE DURING FLIGHT CYCLE												

REMARKS:

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 16 OF ___

RIG NO. G-7

TYPE OF TEST [illegible] Functional Test PLAN OF TEST NO. 222 PT-31 [illegible] A

W.P.I. NO. [illegible] CCS-A02B SERIAL NO. ___ PART NO. 762[illegible]

DATE 11-25-75

ENGINEER [illegible]

OPERATORS S. [illegible]

TIME	[illegible]	[illegible]	Pos.	RPM	Flow	Lube oil	[illegible]	S/O oil		[illegible]	[illegible]	oil	[illegible]	[illegible]	[illegible]	[illegible]
1238	1 24	8 37		Completed 23rd Flight cycle & Started 24th cycle												
1243	1 29	8 42		3411	210	100	2950	17		98°	113°	112°	112°	0.1	0.2	Tau.9[illegible]
1246	1 32	8 45		Completed 24th Flight cycle & Started 25th cycle												
1250	1 36	8 49		3063	211	106	2975	17		98°	114°	112°	112°	0.2	0.2	+ 35.15
1254	1 40	8 53		Completed 25th Flight cycle & Started 26th cycle												
1300	1 46	8 59		3065	211	100	2525	17		97°	120°	112°	112°	0.2	0.3	+ 66.5[illegible]
1302	1 45	9 01		Completed 26th Flight cycle & Started 27th cycle												
1305	1 51	9 04		3063	213	100	3025	16.5		101°	115°	113°	111°	0.1	0.2	+ 64.91
1310	1 56	9 09		Completed 27th Flight cycle & Started 28th cycle												
1314	2 00	9 13		3066	213	106	2900	16.5		102°	118°	114°	112°	0.2	0.3	Tau.61
1317	2 03	9 16		Completed 28th Flight cycle & Started 29th cycle												
1320	2 06	9 19		3066	214	100	3000	16.5		101°	125°	115°	111°	0.1	0.2	+ 35.12
1323	2 09	9 22		Completed 29th Flight cycle & Started 30th cycle												
1324	2 10	9 23		3066	214	100	3000	16.5		100°	117°	114°	113°	0.1	0.3	+ 64.62
STOP 1330	2 16	9 29		Completed 30th Flight cycle shut down for inspection												

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WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET 11 OF ___
DATE 11-2?-75
ENGINEER D. W[illegible]
OPERATORS [illegible]

RIG NO C-7
TYPE OF TEST C-7 DC Sec Actuator Functional Test
PLAN OF TEST NO. 222 PT-313 v.A
W.P.I. NO. [illegible]
SERIAL NO. ___
PART NO. [illegible]

UNITS →	[illegible]	[illegible]	Pos	Rig RPM	[illegible]	PSIG	PSIG	PSIG		°F	°F	°F	°F	[illegible]	[illegible]	[illegible]
TIME																
Start 1350	2 16	9 29		2704	203	100	3000	18		115°	101°	107°	98°	0.2	0.5	07.77
1352	2 18	9 31		Start of 31st Flight Cycle												
1355	2 21	9 34		Completed 31st Flight cycle & Started 3[illegible] cycle												
1357	2 23	9 36		3071?	204	100	2550	17		102°	111°	108°	107°	0.1	0.3	79.33
1359	2 25	9 38		Completed 31st Flight cycle & started 32nd cycle												
1404	2 30	9 43		3067	207	100	2750	17		100°	117°	110°	111°	0.2	0.3	101.05
1407	2 33	9 46		Completed 32nd Flight cycle & Started 33rd cycle												
				RAISED SUPPLY PRESSURE DURING FLIGHT CYCLE												
1412	2 38	9 51		3066	209	100	3000	17		100°	119°	111°	111°	0.2	0.3	+05.16
1415	2 41	9 54		Completed 33rd Flight cycle & Started 34th cycle												
1418	2 44	9 57		3066	212	100	3000	17		99°	121°	113°	113°	0.2	0.3	+06.22
1421	2 47	10 00		Completed 34th Flight cycle & Started 35th cycle												
1425	2 51	10 04		3065	213	100	3000	17		98°	118°	113°	112°	0.1	0.3	101.07
1427	2 53	10 06		Completed 35th Flight cycle & Started 36th cycle												
1430	2 56	10 09		3065	215	100	3000	17		98°	124°	114°	112°	0.1	0.2	+06.47
1433	2 57	10 11		Completed 36th Flight cycle & Started 37 cycle												

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO G-7 SHEET 12 OF
TYPE OF TEST GE [illegible] See Actuator Functional Test PLAN OF TEST NO. 222 RT-31 Rev A DATE [illegible]
W.P.I. NO. [illegible] C03-A02B SERIAL NO. PART NO. [illegible] ENGINEER [illegible]
OPERATORS [illegible]

UNITS → TIME	[illegible]	[illegible]	Rig	Rig RPM	PPS Lube Flow	PSIG Lube Oil	PSIG EHV Supply	PSIG G/B Oil		°F Clutch	°F EHV Supply	°F Lube Oil	°F Shroud Temp.	Mils Vib Vert	Mils Vib Horz	[illegible]
[illegible]	3 [illegible]	10 11		3061	213	100	3000	17		98°	119	113°	111°	0.2	0.2	10.15
[illegible]	3 [illegible]	10 18	Completed 37 Flight Cycle & Started 38th cycle													
[illegible]	3 11	10 23		3066	213	100	3000	17		95°	122°	114°	112°	0.2	0.3	10.20
[illegible]	3 13	10 25	Completed 38th Flight Cycle & Started 39th cycle													
[illegible]	3 15	10 30		3065	214	100	3000	17		98°	120°	114	112°	0.2	0.3	10.17
[illegible]	3 23	10 32	Completed 39th Flight Cycle & Started 40th cycle													
[illegible]	3 24	10 [illegible]		3035	214	100	3000	17		93°	120°	114°	111°	0.1	0.2	[illegible]
[illegible]	3 24	10 32	Completed 40th cycle Shut down for inspection.													
1523	3 25	10 38		2703	180	100*	3000	18		113°	97°	96°	55°	0.2	0.3	11.79
[illegible]	3 25	10 40	Start of 41st Flight Cycle													
1530	3 33	10 45		3073	143	100	3000	17		100°	103°	102°	101°	0.1	0.3	101.26
1532	3 35	10 47	Completed 41st Flight cycle & Started 42nd Cycle													
15[illegible]	3 35	10 50		3066	198	100	3000	17		78°	109°	105°	106°	0.2	0.5	105.71
1536	3 39	10 51	Completed 42nd Flight Cycle & Started 43rd Cycle													
1540	3 43	10 55		3064	202	100	3000	17		77°	111°	107°	139°	0.1	0.3	105.[illegible]
1543	3 46	10 55	Completed 43rd Flight Cycle & Started 44th Cycle													

REMARKS: * Brought up EHV Pressure

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. G-[illegible]

TYPE OF TEST [illegible] Functional Test

W.P.I. NO. [illegible]

PLAN OF TEST NO. 2[illegible]

SERIAL NO.

PART NO. 767[illegible]

DATE 11-27-75 SHEET 12 OF

ENGINEER D. Welson

OPERATORS J. Koreck.

UNITS → / TIME	[illegible]	[illegible]	Pars	[illegible] RPM	[illegible]	[illegible] Oil	[illegible]	[illegible] Oil		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1548	3 51	11 03		3065	205	100	3000	17		97°	116°	109°	109°	0.2	0.3	+ 08.06
1550	3 53	11 05	Completed 44th Flight Cycle & Started 45th cycle.													
1553	3 56	11 08		3066	207	100	3000	17		96°	117°	110°	110°	0.1	0.02	05.41
1556	3 59	11 11	Completed 45th Flight Cycles & Started 46th Cycle.													
1559	4 02	11 14		3063	210	100	3000	17		96°	119°	111°	111°	0.1	0.2	05.16
Stop 1602	4 04	11 16	Completed 46th Flight cycle shutdown 2nd mode checklist													

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 14 OF ___

RIG NO. G-7

TYP. OF TEST Gear/Actuator Functional Test

W.P.I. NO. 105-003-A323

PLAN OF TEST NO. 222PT-31 Rev A

SERIAL NO. ___

PART NO ___

DATE ___

ENGINEER ___

OPERATORS ___

UNITS →	[illegible]	[illegible]		RPM	GPS	PSIG	PSIG	PSIG		°F	°F	°F	°F	Mils	Mils	[illegible]
TIME	[illegible]	[illegible]	Press	RPM	Lube Flow	Lube Oil	EHV Supply	(-)/3 Oil		Clutch	EHV Supply	Lube Oil	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	11	4.7	2100	.53	100	0	100		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	[illegible]
[illegible]	[illegible]	11	Fix leak at Servo Shaft													
[illegible]	[illegible]	[illegible]	1.1	2700	[illegible]	100	[illegible]	18.0		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.2	[illegible]
[illegible]	[illegible]	11	[illegible] Shut Down													
[illegible]	[illegible]	11	4.7	2700	[illegible]	100	[illegible]	18.0		114.0	68	111	[illegible]			[illegible]
[illegible]	[illegible]	11	1.7	3000	[illegible]	100	3500	18.0		112.0	74	112	[illegible]	.3	.2	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] Cycle #17													
[illegible]	[illegible]	11	[illegible] #47													
[illegible]	[illegible]	11	Start Cycle #18													
[illegible]	[illegible]	11	4.1	3108	[illegible]	99	3500	17.5		105	109	112	114	.3	.2	[illegible]
[illegible]	[illegible]	11	4.7	[illegible]	[illegible]	99	3500	17.5		[illegible]	116	[illegible]	[illegible]	.3	.2	[illegible]
[illegible]			End Cycle 18													
			[illegible] Cycle #19													
[illegible]	[illegible]	11	4.7	3008	[illegible]	99	3500	17.5		104.6	[illegible]	111	114	3	.2	[illegible]
[illegible]	[illegible]	11	End Cycle #19													
[illegible]	[illegible]	[illegible]	[illegible] Cycle													

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. [illegible]

TYPE OF TEST [illegible] Test & Act [illegible]

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222PT-3 [illegible]

SERIAL NO. [illegible]

PART NO. [illegible]

SHEET 12 OF [illegible]

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS → TIME	[illegible]	[illegible]	[illegible]	RPM	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	12	4.7	3400	.4585	99	3500	17.5		101°	132°	129	126	.3	.2	[illegible]
[illegible]	0	12		End Cycle #51												
[illegible]	0	12	4.7	3408	.4585	99	3500	17.5		102°	135°	125	118.5	.1	.2	-3°
				Start Cycle #52												
				End Cycle #51												
1443	0	12		Start Cycle #52												
1444	0	12	4.7	3400	.4585	99	3500	17.5		103°	138.0	135.0	120.0	.2	.2	-3°
[illegible]	1	12		End Cycle #52 Start Cycle #53												
[illegible]	1	12		3408	.4585	99	3200	17.4		106°	143°	132.0	126	.2	.2	0°
[illegible]	1	12		End Cycle #58 Start Cycle #[illegible]												
[illegible]	1	12														
				3068	.4585	99	3200	17.4		102.5	145.2	135.5	122°	.2	.2	17
				End Cycle #[illegible] Start Cycle #55												
[illegible]	1	12	4.7	3408	.4585	98	3500	17.5		110°	145.5°	129°	130.2	.2	.2	3°
[illegible]	1	1[illegible]		End Cycle Start Cycle #56												
[illegible]	1	12	4.7	3409	.4585	98	3500	17.5		98°	146°	129°	122°	.2	.2	17°
[illegible]	1	12		End Cycle #56 Start Cycle #57												

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ENGINEERING LABORATORIES

SHEET [illegible] OF
DATE [illegible]
ENGINEER [illegible]
OPERATORS [illegible]

RIG NO. [illegible]
TYPE OF TEST [illegible]
W.P.E. NO. [illegible]
PLAN OF TEST NO. 2228 [illegible]
SERIAL NO.
PART NO.

UNITS → TIME																
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	98	3600	17.5		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			Start Cycle #36													
[illegible]	[illegible]	[illegible]	4.7	815	[illegible]	99	3600	17.5		100°	125	[illegible]	121°	.3	.2	49°
[illegible]			[illegible] Cycle #37													
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible] 56	99	3600	17.5		100°	118°	130°	118.5	.2	.2	[illegible]
[illegible]			[illegible] Cycle #4													
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	3600	17.5		100.5	[illegible]	129.5	121°	.2	.2	49°
[illegible]	[illegible]	[illegible]	4.1	700	[illegible]	99	3600	17.5		103°	133.5	129.6	120.7	.3	.2	[illegible]
[illegible]			[illegible] Cycle #40 - Removed [illegible] Assy. Inspected													

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LOG OF TEST
ENGINEERING LABORATORIES

DATE 12-9-75 SHEET 17 OF ___
ENGINEER D. [illegible]
OPERATORS J. [illegible]

RIG NO. G-7
TYPE OF TEST GE QCSEE Actuator Functional Test PLAN OF TEST NO. 222PT-31 Rev A
W.P.I. NO. 109-C03-A02B SERIAL NO. ___ PART NO. 2C2[illegible]

UNITS → / TIME	Test Time	Total Time	Ratio	Rig RPM	GPS Lube Flow	PSIG Lube Oil	PSIG EHV Supply	PSIG G/B Oil		°F #1 Clutch	°F #3 EHV Supply	°F #4 Lube Oil	°F #6 Ground Exh.	Mils Vib Vert	Mils Vib Horiz	Deg Blade Angle
*Start 1112	0	13 02	4.7	2707	100.5	98	3400	18.5		96°	55°	57°	58°	.4	.5	+09.66
1120	0 02	13 14		2065	124	99	3200	18		95°	75°	71°	53°	.2	.3	+05.53
	Completed Flight Cycle #61 & Started cycle #62															
1138	0 15	13 22		3065	145	99	3500	18		95°	86°	78°	90°	.2	.3	+06.22
Stop 1130	0 18	13 24	Stopped blades not changing pitch hit limit switch													
Start 1210	0	13 24	4.7	2704	120	98	3500	19		105°	76°	71°	66°	.3	.4	+12.14
1213	0 03	13 27	Start Flight Cycle #62													
1220	0 10	13 32	Completed Flight Cycle #62 & Started #63													
1222	0 12	13 37	4.7	3088	157	98	3200	19		97°	98°	86°	90°	.1	.2	+05.40
1225	0 15	13 42	Completed Flight Cycle #63 & Started cycle #64													
1227	0 17	13 44	4.7	3408	160	98	3000	19		96°	100°	91°	94°	.2	.3	+05.57
1230	0 20	13 47	Completed Flight Cycle #64 & Started cycle #65													
1235	0 25	13 52	4.7	2700	181	98	3450	19		75°	106°	96°	77°	.2	.2	+07.27
1237	0 27	13 54	Completed Flight Cycle #65 and Started #66													
1239	0 29	13 56	4.7	3066	153	98	3400	19		76°	108°	97°	97°	.1	.1	+05.32
1242	0 32	13 59	Complete Flight cycle 66 & Started #67													

REMARKS: *Start of Flight Cycle #61

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OF POOR QUALITY

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 19 OF ___

DATE 12-[illegible]

ENGINEER [illegible]

OPERATORS [illegible]

S.O. NO. G-7

TYPE OF TEST G.E. [illegible] sec Actuator Functional Test

PLAN OF TEST NO. 2227T-21 [illegible]

W.P.I. NO. [illegible]-C03-A028

SERIAL NO.

PART NO. 762570

UNITS →	[illegible]	[illegible]			CPS	PSIG	PSIG	PSIG		#1 °F	#2 °F	#4 °F	#5 °F	Mils	Mils	Deg
TIME	Cum. Time	Test Time	Pose	[illegible] RPM	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Shut[illegible]	EHV [illegible]	Lube Oil	[illegible]	Vib [illegible]	[illegible]	[illegible]
12[illegible]	0[illegible]	14[illegible]	4.7	3068	186	98	3500	18		76°	112°	[illegible]	79°	.1	.1	[illegible]
1247	0 37	14 08	Completed Flight cycle #67 and started #68													
12[illegible]	0 40	14 07	4.7	2700	171	98	3600	18		9[illegible]°	117°	1[illegible]°	77°	.1	.1	[illegible]
12[illegible]	0 42	14 09	Completed Flight cycle #68 & started #69													
12[illegible]	0 44	14 11	4.7	2[illegible]	191	98	3600	10		9[illegible]°	11[illegible]°	10[illegible]°	98°	.1	.1	[illegible]
12[illegible]5	0 45	14 12	Completed Flight cycle #69 and started #70													
1251	0 47	14 14	4.7	34[illegible]	173	78	3600	18		95°	111°	10[illegible]°	78°	.1	.2	[illegible]
1300	0 50	14 17	Completed Flight cycle #70 and started #71													
1301	0 51	14 18	4.7	3066	194	98	3700	15		94°	127	104°	78°	.1	.1	[illegible]
1305 [illegible]	0 56	14 23	Completed Flight cycle #71. Stopped to make [illegible] check [illegible]													
1330	0	14 23	Started Flight cycle #72.													
1331	0 01	14 24	4.7	3405	162	98	3600	19		100°	125°	9[illegible]°	78°	.2	.3	[illegible]
1340	0 10	14 34	Completed Flight cycle #72 and started #73 [illegible]													
1341	0 11	14 35	4.7	2700	173	99	3550	19		95°	12[illegible]°	9[illegible]°	88°	.2	.3	[illegible]
1347	0 17	14 41	Completed Flight cycle #73 and started cycle #74													
1347	0 17	14 43	4.1	3404	194	98	3550	17		93°	122°	104°	94°	.2	.3	[illegible]

REMARKS:

REPORT NO. HSER 7002

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Hamilton Standard DIVISION OF UNITED AIRCRAFT CORP

WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

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SHEET 19 OF ___

DATE 12-6-7_

ENGINEER ___

OPERATORS ___

RIG NO. ___

TYPE OF TEST See Act ___

W.P.I. NO. 109- C0 ___

PLAN OF TEST NO. 22 ___

SERIAL NO. ___

PART NO. ___

UNITS →																
TIME																
1359	0 27	14 55	4.7	Completed Flight Cycle #145 Started cycle #75										.3	.4	07.27
1400	0 28	14 57	4.7	2700	198	98	3550	15.5		94°	130°	106°	95°	.3	.4	07.27
1400	0 30	14 54		Completed Flight Cycle #75 and started cycle #76												
1402	0 32	14 56	4.7	3068	200	98	3550	15.5		91°	135°	107°	77°	.1	.2	04.55
1405	0 33	14 57		Completed Flight Cycle #76 and started cycle #77										.1	.3	03.10
1406	0 36	15 00	4.7	3405	201	98	3550	15.5		90°	131°	107°	98°	.1	.3	03.10
1412	0 42	15 06		Completed Flight cycle #77 & started cycle #78												
1418	0 45	15 12	4.7	2700	203	98	3550	15.5		91°	125°	108°	97°	.2	.3	-10.04
1420	0 50	15 14		Completed Flight cycle #78 and started cycle #79												
1422	0 52	15 16	4.7	3064	202	98	3550	15.5		92°	137°	108°	97°	.1	.2	03.17
1425	0 55	15 19		Completed Flight cycle #79 and started cycle #80												
1430	0 60	15 24	4.7	3407	204	98	3550	15.5		91°	129°	108°	98°	.1	.1	00.73
1432	1 02	15 26		Completed Flight Cycle #80 and started cycle #81												
1436	1 06	15 30	4.7	2700	200	98	3550	18		93°	130°	107°	94°	.2	.3	00.67
1438	1 09	15 32		Completed Flight Cycle #81 and Started Cycle #82												
1440	1 10	15 34	4.7	3068	201	98	3550	18		92°	128°	107°	93°	.1	.2	03.26

REMARKS:

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DIVISION OF UNITED AIRCRAFT CORP.
WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. [illegible] SHEET 20 OF
TYPE OF TEST [illegible] Acceptance/Functional 2.1 PLAN OF TEST NO. 222 PT-31 Rev A DATE 12-[illegible]
W.P.I. NO. [illegible] SERIAL NO. PART NO. [illegible] ENGINEER [illegible] OPERATORS [illegible]

UNITS → / TIME	[illegible]	[illegible]	[illegible]	RPM	GPS Lube Flow	PSIG Lube Oil	PSIG Supply	PSIG G/B Oil		#1 T	#3 T	# T	#5 T	Mils	Mils	[illegible]
[illegible]	1 22	15 [illegible]	Completed Flight Cycle #82 and started cycle # [illegible]													
1448	1 23	15 42	4.7	3448	201	79	3550	18		93	136	107°	95°	.1	.1	[illegible]
1455	1 25	15 48	Completed Flight Cycle #83 and started cycle #84													
1459	1 26	15 50	4.7	2700	204	98	3550	18		90°	129°	109°	99°	.1	.1	100%
1500	1 25	15 52	Completed Flight Cycle #84 and started cycle #85													
1501	1 29	15 53	4.7	3068	204	98	3550	18		92°	138°	108°	98°	.1	.1	103%
1504	1 32	15 [illegible]	Completed Flight Cycle #85 and started cycle #86													
1505	1 36	16 00	4.7	3448	205	98	3550	18		96	135°	107°	99°	.1	.1	100%
1510	1 38	16 02	Completed Flight Cycle #86 and started cycle #87													
1513	1 41	16 05	4.7	2700	206	98	3550	18		90°	139°	109°	99°	.1	.1	100%
[illegible]	1 42	16 06	Completed Flight Cycle #87 and started cycle #88													
[illegible]	1 45	16 09	4.7	3068	204	98	3550	18		92°	137	109°	99°	.1	.1	103%
1518	1 46	16 10	Completed Flight Cycle #88 and started cycle #89													
[illegible]	1 48	16 12	4.7	3448	206	98	3550	18		38°	130°	109°	100°	.1	.1	100%
1521	1 49	16 13	Completed Flight Cycle #89 and started Cycle #90													
1525	1 53	16 17	4.7	2700	206	98	3550	18		90°	132°	107°	100°	.1	.1	100%

REMARKS:

REPORT NO. HSER 7002

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. [illegible]
TYPE OF TEST [illegible] Sea Adv. [illegible]
W.P.I. NO. [illegible] 003-7[illegible]
PLAN OF TEST NO. 2[illegible]
SERIAL NO.
PART NO. [illegible]
DATE 12-8-75
ENGINEER [illegible]
OPERATORS [illegible]

UNITS → / TIME	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1520	1 21	16 15	4.7	Completed Flight cycle #90 and started cycle #91												85.
1523	1 51	16 21	4.7	3069	205	98	3550	13		71°	135°	109°	100°	.1	.1	85.7
[illegible]	1 55	16 22		Completed Flight cycle #91 and started cycle #92												
1531	2 02	16 26	4.7	3409	207	98	3550	18		91°	132°	110°	100°	.1	.1	100.92
1535	2 03	16 27		Completed Flight cycle #92 and started cycle #93												
1533	2 06	16 30	4.7	2700	206	98	3550	18		90°	130°	109°	99°	.1	.1	100.92
1546	2 13	16 37		Completed Flight cycle #93 and started cycle #94												
1549	2 16	16 40	4.7	3409	207	98	3550	18		93°	130°	107°	94	.1	.1	07.56
1552	2 20	16 44		Completed Flight cycle #94 and started cycle #95												
1553	2 21	16 45	4.7	3069	204	95	3550	18		91°	135°	109°	99°	.1	.1	03.76
1555	2 23	16 47		Completed Flight cycle #95 and started cycle #96												
1602	2 30	16 54	4.7	2700	207	98	3550	18		89°	131°	110°	100°	.1	.1	100.96
1603	2 31	16 55		Completed Flight cycle #96 and started cycle #97												~~+7~~
1604	2 32	16 56	4.7	3069	206	98	3550	18		91	135°	110°	99	.1	.1	+7
1606	2 34	16 58		Completed Flight cycle #97 and started cycle #98												
1608	2 36	16 60	4.7	3409	206	98	3550	18		92°	130°	110°	98°	.1	.1	07.75

REMARKS:

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Hamilton Standard
DIVISION OF UNITED AIRCRAFT CORP. U A

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. -

TYPE OF TEST [illegible]

W.P.I. NO. [illegible]

PLAN OF TEST NO. [illegible]

SERIAL NO.

PART NO. [illegible]

DATE 12-[illegible] SHEET 32 OF

ENGINEER [illegible]

OPERATORS [illegible]

UNITS → / TIME																
1740	40	17 08	4.7	Completed Flight Cycle #99 [illegible]												
1611	45	17 09	4.7	2700	207	98	3550	17		90°	130°	110°	100°	.1	.1	[illegible]
1616	46	17 10		Completed Flight Cycle #99 [illegible] #100												
1617	47	17 11	4.7	3068	207	98	3550	18		90°	130°	110°	100°	.1	.1	93[illegible]
[illegible]	57	17 17		Completed Flight Cycle #100 [illegible] Section [illegible]												
1800	58	17 22		3020	136	98	3500	18		110	124	75	79	.1	.15	11.6[illegible]
1805				START Flight Cycle #101												
1815	28	17 32		Stop to check valve & control												
START 1830	28	17 32		2700	154	98	3500	18		102	114	85	67	.1	.15	11.63
1835		17		start Flight Cycle #101												
1840	18	17 42	4.7	3065	170	98	3550	18		92	125	91	87	.1	.1	[illegible]
1842	30	17 44		Completed Flight Cycle #101 Started Cycle #102												
1845	23	17 47	4.7	3063	189	98	3550	18		91	129	101	96	.1	.1	06[illegible]
1847	25	17 49		Completed Flight Cycle #102 Started Cycle #103												
1852	30	17 54	4.7	3066	179	98	3550	18		91	131	105	98	.1	.1	[illegible]
1855	35	17 57		Completed Flight Cycle #103 Started Cycle #104												

REMARKS.

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WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET 23 OF

DATE 12-8-73

ENGINEER D Nelson

OPERATORS S Hunt

154

F.O. NO. [illegible]

TYPE OF TEST [illegible] EFF Actuator Functional

PLAN OF TEST NO. Test 222 DT-3[illegible] [illegible] A

W.P.I. NO. [illegible] CC3-A12B

SERIAL NO.

PART NO.

UNITS → / TIME	Test	Total	[illegible]	[illegible]	[illegible]	PSIG	PSIG	PSIG		#1 °F	#3 °F	#4	#5	[illegible]	[illegible]	[illegible]
1858	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3550	18		72	122	107	120	.1	.1	[illegible]
1900	[illegible]	18[illegible]	Completed Flight cycle #104 Started cycle #105													
1904	[illegible]	18[illegible]	[illegible]	3064	[illegible]	98	3550	18		91	124	108	101	.1	.15	[illegible]
Stop 1908	[illegible]	18[illegible]	Completed Flight Cycle #105 Shut down for [illegible]													
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	98	3550	18		102	92	74	[illegible]	.1	.18	[illegible]
2002	[illegible]	[illegible]	Start Flight cycle #106													
2005	[illegible]	[illegible]		3071	[illegible]	78	3550	18		76	115	51	85	.1	.1	[illegible]
2007	3[illegible]	18[illegible]	Completed Flight Cycle #106 Started Cycle #107													
2011	3[illegible]	18[illegible]	4.7	3066	113	98	3550	18		94	118	90	74	.1	.1	[illegible]
2013	4[illegible]	18[illegible]	Completed Flight Cycle #107 Started Cycle #108													
2018	4[illegible]	18[illegible]	4.7	3066	190	98	3550	18		94	125	102	77	.1	.1	[illegible]
2020	4[illegible]	18[illegible]	Completed Flight Cycle #108 Started Cycle #109													
2021	[illegible]	18[illegible]	4.7	3066	197	78	3550	18		94	122	105	79	.1	.1	[illegible]
2026	[illegible]	18[illegible]	Completed Flight Cycle #109 Started #110													
2027	[illegible]	18[illegible]	4.7	3065	200	78	3550	18		94	123	107	99	.1	.1	[illegible]
[illegible]	4[illegible]	18[illegible]	Completed Flight Cycle #110 Started Cycle #111													

REMARKS:

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 21 OF ___
DATE [illegible] 75
ENGINEER [illegible]
OPERATORS [illegible]

RIG NO. [illegible]
TYPE OF TEST GCSFE Starter Functional Test
PLAN OF TEST NO. [illegible]
W.P.I. NO. [illegible]
SERIAL NO.
PART NO.

UNITS →																
TIME	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Mils Disp.
[illegible]			4.1	3065	202	98	3550	15		94	[illegible]	108	100	.1	.1	5.62
2033	[illegible]	13	Completed Flight Cycle #111 Started Cycle #112													
[illegible]	4	13	4.1	3065	203	98	3550	18		94	[illegible]	108	101	.1	.1	5.77
[illegible]	[illegible]	13	Completed Flight Cycle #112 Started Cycle #113													
[illegible]	[illegible]	17	4.1	3063	204	98	3550	18		94	[illegible]	108	10.	.1	.1	6.37
[illegible]	[illegible]	[illegible]	Completed Flight Cycle #113 Started Cycle #114													
[illegible]	[illegible]	14	4.1	3064	204	98	3550	14		94	[illegible]	.09	100	.1	.1	5.31
[illegible]	1	14	Completed Flight Cycle #114 Started Cycle #115													
[illegible]	4 [19]	14 [13]	4.1	3063	205	98	3550	15		94	[illegible]	109	100	.1	.1	5.42
Stop [illegible]	[illegible]	14	Completed Flight Cycle #115 Shut Down For inspection													
			Torque on Beta Regulator Limit													
			About 20 in lb in either direction													
Start [illegible]	4	14		2700	144	98	3550	18		102	[illegible]	91	72	.1	.15	10.04
2142	[illegible]	[illegible]	Start Cycle #116													
[illegible]	[illegible]	[illegible]	4.7	3065	170	98	3550	15		97	[illegible]	90	87	.1	.1	5.77
2177	4	[illegible]	Completed Flight Cycle #116 Start Cycle #117													

REMARKS:

REPORT NO. HSER 7002

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 25 OF ___
DATE 12-3-75
ENGINEER [illegible]
OPERATORS [illegible]

RIG NO. [illegible]
TYPE OF TEST [illegible] Actuator Functional Test
PLAN OF TEST NO. [illegible] A
W.P.I. NO. [illegible]
SERIAL NO.
PART NO.

UNITS → TIME																
[illegible]	5^{32}	19^{29}	4.7	3064	199	98	3550	18		97	124	101	99	.1	.1	[illegible]
[illegible]	5^{07}	19^{31}		Completed Flight Cycle					#117	Start Cycle			#118			
[illegible]	5^{15}	19^{34}	4.7	3064	200	98	3550	18		96	125	117	100	.1	.1	[illegible]
2201	5^{13}	19^{31}		Completed Flight Cycle					#118	Start Cycle			#119			
[illegible]	5^{17}	19^{41}	4.7	3064	304	98	3550	18		96	126	109	100	.1	.1	[illegible]
2207	5^{19}	19^{41}		Completed Flight Cycle					#119	Start Cycle			#120			
[illegible]	5^{25}	19^{49}	4.7	3065	205	98	3550	18		96	133	109	101	.1	.1	[illegible]
2215	5^{27}	19^{51}		Completed Flight Cycle					#120	Start Cycle			#121			
2230	5^{32}	19^{56}	4.7	3064	206	98	3550	18		97	130	109	101	.1	.1	[illegible]
[illegible]	5^{34}	19^{58}		Completed Flight Cycle					#121	Start Cycle			#122			
[illegible]	5^{38}	20^{02}	4.7	3064	206	98	3550	18		96	128	110	102	.1	.1	[illegible]
[illegible]	5^{42}	20^{04}		Completed Flight Cycle					#122	Start Cycle			#123			
[illegible]	5^{46}	20^{05}	4.7	3063	206	98	3550	18		97	129	110	101	.1	.1	[illegible]
2237	5^{49}	20^{08}		Completed Flight Cycle					#123	Start Cycle			#124			
2241	5^{53}	20^{12}	4.7	3065	206	98	3550	18		97	142	110	101	.1	.1	[illegible]
2244	5^{26}	20^{15}		Completed Flight Cycle					#124	Start Cycle			#125			

REMARKS:

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Hamilton Standard — U.A.

WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET 26 OF ___

RIG NO. C-7

TYPE OF TEST GE QCSEE Actuator Func

W.P.I. NO. 109-C03-A02B

PLAN OF TEST NO. 222 PT-31 Rev. A

SERIAL NO.

PART NO [illegible]

DATE 12-5-75

ENGINEER D. Nelson

OPERATORS S. Hunt

UNITS → / TIME	Test Time	Total Time	PARA	RIG RPM	CPS Lube Flow	Psig Lube Oil	Psig EHV Supply	Psig C/B Oil		#1 °F Switch	#3 F/H Supply	#4 Lube Oil	#5 °F Shroud Temp	Mils Vib Vert	Mils Vib Horz	Deis Vib A
2249	5 31	20 20	4.7	3063	208	98	3550	18		97	142	111	103	.1	.1	+ 05.01
2252	5 34	20 23	Completed Flight Cycle #125 Start Cycle #126													
2256	5 38	20 27	4.7	3064	208	98	3550	18		97	132	110	102	.1	.1	+ 06.73
2259	5 41	20 30	Completed Flight Cycle #126 Start Cycle #127													
2304	5 46	20 35	4.7	3063	210	98	3550	18		97	129	111	103	.1	.1	+ 05.6[illegible]
Stop 2306	5 48	20 37	Completed Flight Cycle #127 - Change Paper on Sanborn													
Start 2332	5 48	20 37		2700	160	98	3550	18		104	112	85	76	.1	.15	+ 12.58
2335	5 51	20 40	Start Cycle #128													
2339	5 55	20 44	4.7	3067	178	98	3550	18		95	136	94	93	.1	.1	+ 06.52
2342	5 58	20 47	Completed Flight Cycle #128 Start Cycle #129													
2345	6 01	20 50	4.7	3064	193	98	3550	18		94	127	103	98	.1	.1	+ 06.6[illegible]
2348	6 04	20 53	Completed Flight Cycle #129 Start Cycle #130													
2351	6 07	20 56	4.7	3064	201	98	3550	18		95	126	108	100	.1	.1	+ 05.74
2354	6 10	21 02	Completed Flight Cycle #130 Start Cycle #131													
2357	6 13	21 05	4.7	3064	203	98	3550	18		95	130	109	101	.1	.1	+ 05.20
2400	6 16	21 08	Completed Flight Cycle #131													

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HSF 1750 [illegible]

Hamilton Standard
WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. [illegible]
TYPE OF TEST [illegible] Actuator Functional Test
W.P.I. NO. [illegible]
PLAN OF TEST NO. 229 PT-21 [illegible]
SERIAL NO.
PART NO.
SHEET 27 OF
DATE 12-[illegible]
ENGINEER [illegible]
OPERATORS [illegible]

UNITS → / TIME	[illegible]	[illegible]	[illegible]	[illegible]	CPS	Pres	Pres Supply	Pres		[illegible]	#3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]				[illegible] MOVE BLADES AT MESH INPUT 35 [illegible]												
[illegible]	[illegible]	21 [illegible]	4.7	[illegible]	78	78	3600	17		100°	[illegible]	[illegible]	[illegible]	.3	.4	[illegible]
[illegible]	0 [illegible]	21 11	Start flight cycle #1 [illegible]													
0905	0 05	21 15	4.7	3060	116	78	3575	19		96°	97°	61°	77°	.2	.3	[illegible]
[illegible]	0 09	21 16	Completed flight cycle #132 and started cycle #133													
[illegible]	0 [illegible]	21 17	4.7	[illegible]	143	78	3575	17		77°	74	73°	87°	.1	.2	07[illegible]
[illegible]	0 14	21 22	Completed flight cycle #133 and started cycle #134													
[illegible]	0 15	21 25	4.7	2700	173	78	3575	19		94°	115	94°	79°	.2	.3	[illegible]
0916	0 16	21 27	Completed flight cycle #134 and started cycle #135													
[illegible]	0 [illegible]	21 30	4.7	3066	183	78	3575	18		95°	107°	76°	79°	.1	.3	[illegible]
[illegible]	0 26	21 34	Completed flight cycle #135 and started cycle #136													
[illegible]	0 27	21 36	4.7	3105	191	78	3575	18		97°	126	102°	100°	.1	.2	07.15
[illegible]	0 33	21 41	Completed flight cycle #136 and started cycle #137													
[illegible]	0 39	21 47	4.7	2700	202	78	3550	17.5		94°	123°	103°	103°	.1	.2	[illegible]
[illegible]	0 40	21 4[illegible]	Completed flight cycle #137 and started cycle #138													
[illegible]	0 42	21 52	4.7	3063	203	78	3550	17.5		96°	125°	110°	102°	.2	.2	03.7[illegible]

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. G-7

TYPE OF TEST [illegible] Actuator Functional Test

W.P.I. NO. 130-003-A02B

PLAN OF TEST NO. 222ST-31 Rev A

SERIAL NO.

PART NO. [illegible]

SHEET 29 OF

DATE 12-[illegible]

ENGINEER [illegible]

OPERATORS [illegible]

TIME	[illegible]	[illegible]	Pres	RPM	Lube Flow	PSIG Lube Oil	PSIG EHV Supply	PSIG [illegible]		°F Lube	°F EHV Supply	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		22	4.1	Completed Flight Cycle #138 and Shuttle Cycle #139												
[illegible]		22	4.7	2700	207	98	3550	17.5		95°	130	110°	104°	.1	.2	[illegible]
0953		22	4.7	Completed Flight Cycle #139 and Shuttle Cycle #140												
0954		22	4.7	3400	201	98	3550	17.5		96°	136°	110°	103°	.1	.2	.035[illegible]
[illegible]		22	4.7	Completed Flight Cycle #140 and Shuttle Cycle #141												
1002	1	22	4.7	3063	208	98	3550	17.5		96°	137°	112°	105°	.1	.2	.035[illegible]
1005	1	22	4.7	Completed Flight Cycle #141 and Shuttle Cycle #142												
1012	1	22	4.7	2700	211	98	3550	17.5		94°	115°	115°	105°	.1	.2	[illegible]
1013	1	22	4.7	Completed Flight Cycle #142 and Shuttle Cycle #143												
1014	1	22	4.7	3408	212	98	3550	17.5		96°	137°	111°	105°	.1	.2	[illegible]
1019	1	22		Completed Flight Cycle #143 and Shuttle Cycle #144												
1022	1	22	4.7	3068	213	98	3550	17.5		96°	145°	114°	104°	.1	.2	.037[illegible]
1025	1	22	4.7	Completed Flight Cycle #144 and Shuttle Cycle #145												
1032	1	22	4.7	2700	215	98	3550	17.5		96°	144°	111°	115°	.1	.2	[illegible]
1033	1	22		Completed Flight Cycle #145 and Shuttle Cycle #146												
1037	1	22	47	3405	216	96	3530	17.5		95°	155	11[illegible]°	105	.1	.1	[illegible]

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 29 OF
DATE 12-[illegible]
ENGINEER [illegible]
OPERATORS [illegible]

E.O. NO. 27
TYPE OF TEST [illegible] Functional Test
W.P. NO. [illegible] 23-[illegible]
PLAN OF TEST NO. 222 PT-31 R.V.A
SERIAL NO.
PART NO. [illegible]

TIME	[illegible]	[illegible]	[illegible]	RPM	Lube	Lube oil	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	Mils	Mils	[illegible]
1039	1 31	22 41	4.7	Completed Flight Cycle #146 and started Cycle #147												
1042	1 42	22 50	4.7	3065	216	98	3550	17.5		95°	153°	111°	106°	.1	.1	03.70
1045	1 45	22 53	4.7	Completed Flight Cycle #147 and started Cycle #148												
1050	1 50	22 55	4.7	2700	218	98	3550	17.5		93°	150°	117°	105°	.1	.1	[illegible]
1052	1 52	23 00	4.7	Completed Flight Cycle #148 and started Cycle #149												
1054	1 54	23 02	4.7	3108	217	98	3550	17.5		97°	153°	117°	102°	.1	.1	06.71
1057	1 57	23 05	4.7	Completed Flight Cycle #149 and started Cycle #150												
1100	2 00	23 08	4.7	3065	217	98	3550	17.5		75°	158°	111°	104°	.1	.1	01.76
1105	2 05	23 13	4.7	Completed Flight Cycle #150 and started Cycle #151												
1101	2 03	23 17	4.7	2700	218	98	3550	17.5		73°	157°	117°	105°	.1	.1	[illegible]
1110	2 10	23 18	4.7	Completed Flight Cycle #151 and started Cycle #152												
1112	2 12	23 20	4.7	3405	217	98	3550	17.5		95°	158°	117°	104°	.1	.1	07.20
1117	2 17	23 25	4.7	Completed Flight Cycle #152 and started Cycle #153												
1119	2 19	23 26	4.7	3068	218	98	3550	17.5		95°	158°	118°	105°	.1	.1	03.70
1122	2 22	23 30	4.7	Completed Flight Cycle #153 stopped for lunch.												

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 30 OF

DATE 12-[illegible]

ENGINEER [illegible]

OPERATORS [illegible]

RIG NO. C-7

TYPE OF TEST [illegible] Functional Test

PLAN OF TEST NO. 222YT-31, [illegible] A

W.P.I. NO. [illegible] - C03 - A[illegible]

SERIAL NO.

PART NO. [illegible]

UNITS →	Test	Total		Rig	PPS	PSIG	PSIG	PSIG		°F	°F	°F	°F	Mils	Mils	
TIME	Time	Time	Rev	RPM	Lube Flow	Lube Oil	EHV Supply	GB Oil		Clutch	EHV [illegible]	Lube Oil	[illegible]	[illegible]	Vib	[illegible]
[illegible]	22	23	4.7	[illegible]										.2	.1	[illegible]
1247	24	32	[illegible]		Lost Power [illegible]											
[illegible]	24	32	4.7	[illegible]	12[illegible]	95	3550	20		[illegible]	[illegible]	[illegible]	67°	.2	.1	[illegible]
13[illegible]	26	31	[illegible] Flight Cycle #154													
12[illegible]	27	36	4.7	3700	131	95	3550	17		[illegible]	12[illegible]	[illegible]	[illegible]°	.2	.3	[illegible]
131[illegible]	29	37	[illegible] Flight Cycle #15[illegible] [illegible] cycle #153													
131[illegible]	30	38	4.7	3468	163	95	[illegible]	19		[illegible]	127°	[illegible]	72°	.1	.2	[illegible]
[illegible]	35	43	4.7	[illegible] Flight Cycles #155 [illegible] #156												
[illegible]	36	44	[illegible]													
1[illegible]	36	44	4.7	3700	[illegible]	95	3550	17		103°	90°	92°	65°	.2	.3	[illegible]
[illegible]	37	45	[illegible]	[illegible]	Flight Cycle #157											
[illegible]	40	48	4.7	[illegible]	14[illegible]	95	[illegible]50	18.5		9[illegible]°	10[illegible]°	[illegible]°	84°	.2	.3	[illegible]
[illegible]	43	51		Completed Flight Cycle #156 [illegible] cycle #157												
[illegible]	48	56		[illegible]	178	95	3550	15.5		9[illegible]°	115°	[illegible]	104°	.2	.3	[illegible]
[illegible]	[illegible]	[illegible]		Completed Flight cycle #157 [illegible] cycle #158												
1[illegible]	50	58		3405	183	95	3550	19		[illegible]	113	10[illegible]°	10[illegible]°	.1	.2	3.21

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LOG OF TEST
ENGINEERING LABORATORIES

P.O. NO. ______
TYPE OF TEST ______
W.P.I. NO. ______
PLAN OF TEST NO. ______
SERIAL NO. ______ PART NO. ______

DATE 12-[illegible] SHEET [illegible] OF ______
ENGINEER [illegible]
OPERATORS [illegible]

TIME														VERT	HOR	
1250	2 54	24 08	4.7	Completed Flight Cycle #158 and started #159												
1255	2 57	24 07	4.7	Completed Flight cycle #159 and started #160												
1258	3 02	24 10	4.7	3008	205	90	3550	17.5		94°	127°	110°	113°	.1	.2	18.66
1300	3 04	24 12	4.7	Completed Flight Cycle #160 and started #161												
1304	3 08	24 16	4.7	Completed Flight cycle #161 and started #162												
1306	3 10	24 18	4.7	3408	211	90	3550	17.5		95°	131°	114°	113°	.1	.2	66.95
1310	3 14	24 22	4.7	Completed Flight cycle #162 and started #163												
1315	3 19	24 27	4.7	Completed Flight cycle #163 and started #164												
1317	3 21	24 29	4.7	3408	215	90	3550	17.5		94°	136°	116°	114°	.1	.2	83.91
1319	3 23	24 31	4.7	Completed Flight cycle #164 and started #165												
1324	3 28	24 36	4.7	Completed Flight cycle #165 and started #166												
1327	3 33	24 41	4.7	2700	218	90	3550	17.5		93°	136°	117°	115°	.1	.3	101.00
1330	3 34	24 42	4.7	Completed Flight Cycle #166 and started #167												
1334	3 38	24 46	4.7	Completed Flight cycle #167 and started #168												
1336	3 40	24 48	4.7	3408	217	90	3550	17.5		94°	129°	113°	113°	.1	.2	69.25
1341	3 45	24 53		Completed Flight cycle #168 and started #169												

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. G-7

TYPE OF TEST [illegible] Functional Test

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222PT-31 [illegible]

SERIAL NO.

PART NO.

DATE 12-[illegible] SHEET 32 OF 35

ENGINEER [illegible]

OPERATORS [illegible]

TIME	[illegible]	[illegible]	[illegible]	Rig RPM	[illegible]	PSIG	PSIG	PSIG		Clutch	[illegible]	[illegible]	[illegible]	Vib	Vib	[illegible]
[illegible]	3 [illegible]	[illegible]	4.7	Completed Flight cycle #167 [illegible] #170												
[illegible]	3 24	25 22	4.7	2700	220	90	3550	17.5		34°	131°	117°	115°	.1	.2	01.06
[illegible]	3 55	25 23	4.7	Completed Flight cycle #170 and started #171												
[illegible]	3 27	25 24	4.7	3068	220	90	3550	17.5		74°	143°	117	116°	.1	.2	03.45
[illegible]	3 [illegible]	25 [illegible]	4.7	Completed Flight cycle #171 and started #172												
[illegible]	4 [illegible]	25 [illegible]	4.7	Completed Flight cycle #172 and started #173												
[illegible]	4 [illegible]	25 [illegible]	4.7	3408	221	90	3550	17.5		34°	136°	121°	116°	.1	.2	07.06
[illegible]	4 10	25 [illegible]	4.7	Completed Flight cycle #173 and started #174												
[illegible]	4 [illegible]	25 16	4.7	Completed Flight cycle #174 and started #175												
[illegible]	4 [illegible]	25 [illegible]	4.7	2700	224	90	3550	17.5		34°	137°	122	117	.1	.2	01.10
[illegible]	4 20	25 16	4.7	Completed Flight cycle #175 and started #176												
[illegible]	4 25	25 17	4.7	Completed Flight cycle #176 and started #177												
[illegible]	4 24	25 20	4.7	3068	222	90	3550	17.5		71°	143°	121	116°	.1	.2	03.45
[illegible]	4 27	25 22	4.7	Completed Flight cycle #177 and started #178												
[illegible]	4 32	25 23	4.7	Completed Flight cycle #178 and started #179												
[illegible]	4 33	25 21	4.7	3408	222	90	3550	17.5		71°	136°	121°	116°	.1	.2	06.53

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 33 OF

DATE 12-9-

ENGINEER [illegible]

OPERATORS [illegible]

RIG NO. G-7

TYPE OF TEST [illegible] Sec Actuator Functional Test

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222-RT-31 Rev A

SERIAL NO.

PART NO. [illegible]

UNITS → TIME	Test Time	Total Time	Ratio	Rig RPM	GPS Lube Flow	PSIG Lube Oil	PSIG ENV Supply	PSIG [illegible] Oil		°F Clutch	[illegible]	[illegible]	[illegible]	Mils	Mils	[illegible]
1934	4^{27}	25^{33}	4.7	Completed Flight cycle #179 and Started #180												—
1939	4^{42}	25^{37}	4.7	Completed Flight cycle #180 and Started #181												
1945	4^{48}	25^{43}	4.7	2700	223	90	3550	17.5		93°	141°	121°	117°	.1	.2	T01.15
1946	4^{49}	25^{44}	4.7	Completed Flight cycle #181 and Started #182												
1949	4^{52}	25^{47}	4.7	Completed Flight cycle #182 and Started #183												
1950	4^{53}	25^{48}	4.7	3408	223	90	3550	17.5		93°	134°	121°	116°	.1	.2	T07.17
1955	4^{58}	25^{53}	4.7	Completed Flight cycle #183 and Started #184												
1959	5^{02}	25^{57}	4.7	Completed Flight cycle #184 and Started #185												
2001	5^{03}	25^{58}	4.7	3068	223	90	3550	17.5		95°	144°	122°	117°	.1	.2	T03.10
2004	5^{06}	26^{01}	4.7	Completed Flight cycle #185 and Started #186												—
2009	5^{10}	26^{05}	4.7	Completed Flight cycle #186 and Started #187												
2012	5^{14}	26^{09}	4.7	2700	221	90	3550	17.5		93°	145°	122	117°	.1	.3	T01.03
2013	5^{15}	26^{10}	4.7	Completed Flight cycle #187 and Started #188												
2016	5^{15}	26^{13}		Completed Flight cycle #188												
				Stopped [illegible] Rig. Engineer [illegible] inspection.												

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REPORT NO. **HSER 7002**

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 34 OF

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

RIG NO. C-1

TYPE OF TEST [illegible] Functional Test

PLAN OF TEST NO. 222 XT-31 [illegible]

W.P.I. NO. [illegible] AU2E

SERIAL NO.

PART NO. [illegible]

UNITS →	[illegible]	[illegible]		[illegible]	[illegible]	PSIG	PSIG	PSIG		°F	[illegible]	[illegible]	°F	[illegible]	[illegible]	[illegible]
TIME						[illegible]	[illegible]	[illegible]								
10	5 15	26 13	11.7	3?10	.8556	100	3500	15		102.7	95°	118.4	129.3	.2	.3	+12°
					End Cycle #189											
					Start Cycle #190											
[illegible]	5 23	26 18	11.7	3?00	.8556	99	3500	17.5		98.5	1?0.5	71.6	185°	.2	.3	+1
					End Cycle #190											
					Start Cycle #191											
10	5 29	26 24	11.7	3408	.8556	99	3500	17.5		25.5°	170.6	105.7°	111.0°	.1	.2	-3°
					End Cycle 191											
					Start Cycle #192											
1042	5	26 30	11.7	3408	.8556	99	3500	17.5		93.5°	159.7	115.0°	114.3	.1	.2	.0°
					End Cycle #192											
					Start Cycle #193											
[illegible]	5 11	26 35	11.7	3068	.8556	99	3500	18.0		94.4°	170.3°	116.3°	114.6°	.1	.2	.0°
					End Cycle #193											
					Start Cycle #194											
[illegible]	5 17	26 42	11.7	3068	.8556	99	3500	17.5		94.5°	104.8	112°	118.6°	.1	.2	+7°
					End Cycle #194											
					Start Cycle #195											
1100	5 [illegible]	26 1	11.7	3408	.8556	99	3500	17.5		94°	150.6	116°	106.5°	.1	.2	-10°
					End Cycle #195											
					Start Cycle #196											
1100	5 53	26 52	11.7	3700	.8556	99	3400	17.5		93.7°	113.0°	114.6°	117°	.1	.2	-10°
					End Cycle #196											
					Start Cycle #197											

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WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET 35 OF ___
DATE 12-16-7[illegible]
ENGINEER D. [illegible]
OPERATORS [illegible]

RIG NO. 3-7
TYPE OF TEST [illegible] Actuator Functional Test
W.P.I. NO. 20-[illegible]-702 B
PLAN OF TEST NO. 222PT-31 [illegible]
SERIAL NO.
PART NO. [illegible]

UNITS → / TIME	Cyl	Total	Press	RPS / RPM	LBS Lube Flow	PSIG Lube Oil	PSIG EHV Supply	PSIG [illegible]		°F Hyd.	°F EHV	°F	°F	Mils	Mils	Deg
	[illegible]	[illegible]	4.7			End Cycle #197 / Start Cycle #198										
11 [illegible]	5 04	27 00	4.7	2700	.8550	99 / End Cycle #198 / Start Cycle #199	3400	175		99°	140°	108°	111	.1	.2	[illegible]
11 [illegible]	6 [illegible]	27 06	4.7	2700	.8550	99 / End Cycle #199 / Start Cycle #200	3500	17.5		96.4°	1[illegible]°	1[illegible]°	105°	.2	.3	-3°
11 [illegible]	6 [illegible]	27 11	4.7	3408	.8550	99 / End Cycle #200	3500	12.5		96.1°	145.0	104.2	106°	.1	.2	-3°
Stop 11.30	6 22	27 18		Linen												
TORQUE AT MANUAL INPUT = 30-35 IN LBS																
Start 12 35	6 22	27 18	4.7	2700	.8550	99 / Start Cycle #201 / End Cycle #201 / Start Cycle #202	3500	17.5		109.5°	145.3°	63.9°	71°	.2	.3	+12°
12 41	6 28	27 25	4.7	2700	.8550	99 / End Cycle #202 / Start Cycle #203	3500	17.5		98.2°	129.8°	84.0°	94.6°	.2	.3	-3°
12 46	6 33	27 31	4.7	3108	.8550	99 / End Cycle #203 / Start Cycle #204	3500	17.5		98°	124°	92.0°	101°	.1	.2	-3°
12 57	6 35	27 36	4.7	3108	.8550	99 / End Cycle #204 / Start Cycle #205	3500	17.5		96.7°	133°	111.2°	105°	.1	.2	-0°

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WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

RIG NO.

TYPE OF TEST [illegible] Endurance Test

PLAN OF TEST NO. 322 PT-31 Rev A

W.P.I. NO. [illegible]

SERIAL NO.

PART NO. [illegible]

SHEET [illegible] OF

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS →	Elapsed Time				PSIG	PSIG	PSIG								
TIME	[illegible]	Time	Tach	RPM	Flow	Lube Oil	Elev Supply	G/B Oil		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99 End Cycle [illegible] Start Cycle [illegible]	3500	17.5		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	.9560	99 End Cycle #206 Start Cycle #207	3500	17.5		76°	[illegible]	[illegible]	179°	[illegible]	.2	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	.9565	99 End Cycle 207 Start Cycle #208	3500	17.5		77°	[illegible]	[illegible]	[illegible]	.1	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	3108	.9565	99 End Cycle #208 Start Cycle #209	3500	17.5		77°	[illegible]	[illegible]	[illegible]	.2	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	.9565	99 End Cycle 209 Start Cycle #210	3500	17.5		[illegible]	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]
[illegible]	[illegible]	[illegible]	4.7	3100	.9565	99 End Cycle 210 Start Cycle 211	3500	17.5		94.2° 94	[illegible]	[illegible]	[illegible]	.2	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	2700	.9565	99 End Cycle 211 Start Cycle #212	3500	17.5		75°	[illegible]	[illegible]	[illegible]	.2	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	2700	.9565	99 End Cycle 212 Start Cycle 213	3500	17.5		77.5°	[illegible]	[illegible]	[illegible]	.2	.1	[illegible]

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WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. C-7
TITLE OF TEST: CL OCSEE Actuator Endurance Test
PLAN OF TEST NO. 525 PT 31 Rev A
W.P.I. NO. 100-003-AC 2B
SERIAL NO.
PART NO. [illegible]
DATE 12-10-75
ENGINEER [illegible]
OPERATORS [illegible]

UNITS →	Test Time	Total Time	Temp	RIG RPM	LUBE FLOW	PSIG LUBE OIL	PSIG EHV SUPPLY	PSIG G/B OIL		#1 CLUTCH	#3 EHV SUPPLY	#4 LUBE OIL	#5 °F SHUTTLE TEMP	MILS VERT	MILS HORZ	DEG BLADE ANGLE
13:38	7	28 23	4.7	3408	.85 GPS	~~End Cycle~~ ~~Start Cycle #~~ End Cycle #213 Start Cycle #214		17.5		78.0	140.0	103.2	104.2	.1	.2	-3°
[illegible]	7	28	4.7	3408	.85 GPS	99 End Cycle 214 Start Cycle #215	3500	17.5		72.6	140.9	107.0	106.1	.1	.1	[illegible]
13:??	7 31	28 31	4.7	3068	.85 GPS	99 End Cycle 215 Start Cycle #216	3500	17.5		95.5	132.0	107.2	107°	.1	.1	0°
13:59	7 12	28 32	4.7	3068	.85 GPS	99 End Cycle #216 Start Cycle #217	3500	17.5		96.2	140.0	106.7	107.9°	.1	.1	+7°
13:??	7 42	28 41	4.7	3068	.85 GPS	99 End Cycle #217 Start Cycle #218	3500	17.5		96.7°	140.0	106.4	107.1	.1	.1	-10°
14:03	7 50	28 27	4.7	3408	.85 GPS	99 End Cycle #218 Start Cycle #219	3500	17.5		78.1	140.7	106.3	105.2°	.1	.1	-10°
14:??	7	28 52	4.7	3700	.85 GPS	99 End Cycle #219 Start Cycle #220	3500	17.0		94.2°	139.9	106.1°	106.5	.1	.2	-10°
[illegible]	8	28	4.7	3100	.85 GPS	99	3500	17.0		95.0	137.8	106.4	106.3	.1	.1	+7°
14:15	8 02	28 52				End Cycle #220			MAX EVENT TORQUE 30-35 WABS							

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 35 OF ___
DATE [illegible]
ENGINEER [illegible]
OPERATORS [illegible]

RIG NO. G-7
TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST
PLAN OF TEST NO. 222PT-31 Rev. A
W.P.I. NO. [illegible] B
SERIAL NO. 4
PART NO. 767500

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.2596	[illegible]	[illegible]	17.5		[illegible]	[illegible]	[illegible]	[illegible]	.2	.1	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.5		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	3108	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	3108	.2596	[illegible]	3500	17.5		[illegible]	[illegible]	[illegible]	[illegible]	.1	.1	0°
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	17.5		[illegible]	[illegible]	[illegible]	[illegible]	.1	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	.8596	[illegible]	3500	17.5		[illegible]	137.8	[illegible]	102.0	.1	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	102.0	[illegible]	.1	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	4.7	3108	[illegible]	[illegible]	[illegible]	17.5		76.2	[illegible]	[illegible]	108.1	.2	.1	[illegible]
[illegible]	[illegible]	47	4.7	3700	.2596	99	3500	17.5		[illegible]	137.7	[illegible]	107.5	.1	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	3700	.2556	99	3500	17.5		[illegible]	136.6	[illegible]	107.0	.2	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	105.3	[illegible]	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	.8596	99	3500	17.5		77.8	147.4	[illegible]	[illegible]	.2	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	3108	.2596	97	3500	17.5		72.0	[illegible]	[illegible]	105.9	.1	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	17.5		[illegible]	[illegible]	[illegible]	[illegible]	.1	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	17.5		[illegible]	146.6	[illegible]	105.7	.1	.2	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	17.5		[illegible]	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]

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WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET [illegible] OF

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RIG NO. G-7
TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST
W.P.I. NO. 109-CO3 [illegible]
PLAN OF TEST NO. 222PT-31 Rev. A
SERIAL NO.
PART NO. 767500
DATE 12-16-75
ENGINEER D. [illegible]
OPERATORS [illegible]

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
1100	9^27	30^29	11.7	[illegible]	[illegible]	99	[illegible] 3500	[illegible] 17.5		[illegible]	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]
1105	[illegible]	30^32	11.7	[illegible]	[illegible]	99	[illegible] 3500	[illegible] 17.5		[illegible]	[illegible]	[illegible]	[illegible]	.1	.1	[illegible]
1110	9^37	30^39	11.7	2700	[illegible]	99	[illegible] 3500	[illegible] 17.5		[illegible]	[illegible]	[illegible]	[illegible]	.1	.1	[illegible]
1115	9^42	30^44	11.7	2700	[illegible]	99	[illegible] 3500	17.5		[illegible]	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]
S/D 1120	9^42	30^44	COMPLETED 240 FLIGHT CYCLES - [illegible]													

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 1 OF

RIG NO. G-7

TYPE OF TEST [illegible] Frequency Response Test

PLAN OF TEST NO. 222PT-31 [illegible] A

W.P.I. NO. [illegible]

SERIAL NO. [illegible]

PART NO. [illegible]

DATE [illegible]

ENGINEER D. [illegible]

OPERATORS [illegible]

UNITS → TIME	Test Time	Run Time	[illegible]	[illegible] RPM	[illegible] Flow	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible] Temp	[illegible] Vib	[illegible] Vib	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	77	[illegible]	0	—	[illegible]	[illegible]	—	--	—	—
[illegible]	[illegible]	30 44	[illegible]	[illegible]	[illegible]	77	3560	17	105	381	[illegible]	[illegible]	[illegible]	1	-.2
[illegible]	[illegible]	31 32	[illegible]	2019	[illegible]	77	3560	18.5	104	[illegible]	[illegible]	[illegible]	.1	.1	-3°
[illegible]	[illegible]	31	[illegible] Western Gear Box Bearing [illegible]													

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET [illegible] OF
DATE [illegible]
ENGINEER [illegible]
OPERATORS [illegible]

RIG NO. G-7
TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST
PLAN OF TEST NO. 222PT-31 Rev. A
W.P.I. NO. [illegible]
SERIAL NO.
PART NO. 767500

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	3068	.85	99	START CYCLE 3450	18		105.2	101.7	102.5	[illegible]	.2	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	[illegible]	15		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	3068	.850	[illegible]	[illegible]	18		[illegible]	[illegible]	[illegible]	[illegible]	.2	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	15		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	15		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]
	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	15		[illegible]	[illegible]	[illegible]	[illegible]	.2	.1	[illegible]
			4.7	[illegible]	[illegible]	[illegible]	[illegible]	15		[illegible]	[illegible]	[illegible]	[illegible]	.2	.1	[illegible]
2028	11 05	32 03	4.7	3408	.85	99	3450	18		101.0	133.4	109.6	113.3	.1	.1	-5
2032	11 09	32 06	4.7	3408	.85	99	END CYCLE 252 START CYCLE 253 3450	18		101.2	127.5	109.2	114.2	.1	.1	0
2035	11 15	32 12	4.7	3068	.85	99	END CYCLE 253 START CYCLE 254 3450	18		101.8	124.3	113.9	113.9	.1	.1	0
2043	11 20	32 17	4.7	3068	.85	99	END CYCLE 254 START CYCLE 255 3450	18		102	127.2	109.2	113.2	.1	.1	+7
2046	11 23	32 20	4.7	3068	.85	99	END CYCLE 255 START CYCLE 256 3450	18		102.3	130.2	107.3	112.9	.1	.1	-10

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 41 OF

RIG NO G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222PT-31 Rev. A

SERIAL NO.

PART NO. 767500

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
[illegible]	11 29	33 22	TORQUE AT MIN. 3 INPUT							30-[illegible]	[illegible]	[illegible]	[illegible]			
2115	11 [illegible]	32 [illegible]	4.7	3408	.85	99	3450	18		104	126.5	[illegible]	111.3	.1	.1	-10
[illegible]	11 34	32 31	4.7	2700	.85	99	[illegible]	18		113	[illegible]	[illegible]	108	.1	.1	-10
2126	11 35	32 35	4.7	2100	.85	99	3450	18		99.4	135.5	107.2	109.7	.1	.1	+7
[illegible]	11 40	32 40	4.7	2700	.85	99	3450	18		100.7	[illegible]	108.5	111.3	.1	.1	[illegible]
[illegible]	11 42	32 42	4.7	2700	.85	99	3450	18		102.4	141.6	105.1	109.3	.1	.1	-3
21[illegible]	11 45	32 45	4.7	3408	.85	99	3450	18		102.6	143.0	109.1	109.1	.1	.1	-3
[illegible]	11 [illegible]	32 49	4.7	3408	.85	99	[illegible]	18		112.3	143.0	109.8	111.1	.1	.1	0
[illegible]	11 54	[illegible] 53	4.7	3068	.85	99	[illegible]	18		100.9	133.[illegible]	110.5	111.6	.1	.1	0
[illegible]	12 01	33 58	4.7	3068	.85	99	[illegible]	18		101.6	[illegible]	[illegible]	111.1	.1	.1	+7
[illegible]	12 07	33 04	4.7	3068	.85	99	[illegible]	18		101.6	[illegible]	111.7	111.8	.1	.1	-10
[illegible]	12 12	33 09	4.7	3408	.85	99	[illegible]	18		101.6	140.7	111.3	112.2	.1	.1	-100
[illegible]	12 15	33 12	4.7	2700	.85	99	[illegible]	18		98.4	132.2	113.0	113.6	.1	.1	-100
2207	12 [illegible]	33 16	4.7	2700	.85	99	[illegible]	18		99.4	143.6	111.6	112.5	.1	.1	+7
[illegible]	12 [illegible]	32 20	4.7	2700	.85	99	3450	18		98.4	[illegible]	[illegible]	[illegible]	.1	.1	+12
[illegible]	12 26	[illegible] 29	4.7	2700	.85	99	3450	18		101.6	147.7	111.1	111.5	.1	.1	-3

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ENGINEERING LABORATORIES

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E.G. NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

W.P.I. NO. [illegible] B

PLAN OF TEST NO. 222PT-31 Rev. A

SERIAL NO.

PART NO. 767500

SHEET [illegible] OF

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS ▸						PSIG	PSI[illegible]	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
2218	13 30	33 24	4.7	3068	.85	99	End Cycle Start Cycle 3050	271 272 18		100.3	149.0	111.3	111.5	.1	.1	-3
2222	13 34	33 28	4.7	3068	.85	99	End Cycle Start Cycle 3050	272 273 18		100.0	149.0	111.6	111.5	.1	.1	[illegible]
2226	13 38	33 36	4.7	3065	.85	99	End Cycle Start Cycle 3050	273 274 18		99.9	[illegible]	111.5	112.3	.1	.1	0
2230	13 42	33 40	4.7	3068	.85	99	End Cycle Start Cycle 3050	274 275 18		99.7	145.6	111.9	112.2	.1	.1	+7
2236	13 48	33 46	4.7	3065	.85	99	End Cycle Start Cycle 3050	275 276 18		100.6	145.0	111.7	112.5	.1	.1	-100
2240	13 52	33 50	4.7	3408	.85	99	End Cycle Start Cycle 3050	276 277 18		100.1	141.5	111.7	112.0	.1	.1	-100
2246	13 58	33 56	4.7	2700	.85	99	End Cycle Start Cycle 3050	277 278 18		99.6	141.5	111.5	112.5	.1	.1	-100
2250	13 02	34 00	4.7	2700	.85	99	End Cycle Start Cycle 3050	278 279 18		98.6	137.5	111.6	112.1	.1	.1	+7
2255	13 07	34 05	4.7	2700	.85	99	End Cycle Start Cycle 3050	279 280 18		98.2	[illegible]	111.7	112.2	.1	.1	+12
[illegible]	13 07	34 07	4.7	2700	.85	99	End Cycle Start Cycle 3050	280 281 18		101.2	148.2	111.2	110.5	.1	.1	-3
[illegible]	13 11	34 12	4.7	3408	.85	99	End Cycle Start Cycle 3050	281 282 18		[illegible]	148.2	111.6	110.0	.1	.1	-3
[illegible]	13 18	34 16	4.7	3408	.85	99	End Cycle Start Cycle 3050	282 283 18		100.2	[illegible]	112.1	111.7	.1	.1	0
[illegible]	13 22	34 20	4.7	3068	.85	99	End Cycle Start Cycle 3050	283 284 18		99.7	141.6	111.7	111.3	.1	.1	0
[illegible]	13 27	34 25	4.7	3068	.85	99	End Cycle Start Cycle 3050	284 285 18		99.1	137.7	111.3	110.7	.1	.1	+7
[illegible]	13 [illegible]	34 [illegible]	4.7	3068	.85	99	End Cycle Start Cycle 3050	285 286 18		100.5	142.8	111.7	112.0	.1	.1	-100
[illegible]	13 [illegible]	34 31	4.7	3468	.85	99	End Cycle Start Cycle 3050	286 287 18		99.9	142.8	108.8	110.7	.1	.1	-100

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 113 OF ___

DATE 12-15-75

ENGINEER D. [illegible]

OPERATORS S. [illegible]

RIG NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

PLAN OF TEST NO. 222PT-31 Rev. A

W.P.I. NO. [illegible]

SERIAL NO.

PART NO. 767500

UNITS →						PSIG	PSI	PSIG						MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		#1 Clutch	#3 EHV Supply	#4 Lube Oil	#5 Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
[illegible]	[illegible] 46	34 42	4.7	2700	.85	99	End cycle [illegible] Start cycle [illegible] [illegible]	[illegible] 18		96.[illegible]	[illegible]	[illegible]	[illegible]	.1	.1	[illegible]
2338	13 50	34 47	4.7	2700	.85	99	End cycle Start cycle 3450	[illegible] 18		96.8	144.6	112.9	110.8	.1	.1	+7
2343	13 53	34 52	4.7	2700	.85	99	End cycle Start cycle 3450	289 290 18		97.5	141.2	[illegible]	110.7	.1	.1	+12
2345	13 57	34 57	4.7	2700	.85	99	End cycle Start cycle 3450	[illegible] 291 15		99.7	142.6	110.3	109.5	.1	.1	-3
2358	14 02	35 02	4.7	3108	.85	99	End cycle Start cycle 3450	291 292 18		102.9	142.9	110.3	112.9	.1	.1	-3
0002	14 07	35 11	4.7	3108	.55	99	End cycle Start cycle 3450	292 293 18		101.7	143.5	107.8	106.4	.1	.1	0
0007	14 11	35 16	4.7	3068	.85	99	End cycle Start cycle 3450	293 294 18		99.9	146.3	108.3	105.4	.1	.1	0
0011	14 23	35 20	4.7	3068	.85	99	End cycle Start cycle 3450	294 295 18		98.2	142.3	107.2	110.3	.1	.1	+7
0015	14 27	35 24	4.7	3068	.85	99	End cycle Start cycle 3450	295 296 18		99.1	144.0	107.8	111.1	.1	.1	-100
0020	14 32	35 27	4.7	3108	.85	99	End cycle Start cycle 3450	296 297 18		100.5	141.9	107.7	107.9	.1	.1	-100
0025	14 37	35 32	4.7	2700	.85	99	End cycle Start cycle 3450	297 298 18		95.6	137.3	107.5	109.6	.1	.1	-100
0029	14 41	35 38	4.7	2700	.85	99	End cycle Start cycle 3450	298 299 18		96.5	142.5	109.3	109.9	.1	.1	+7
0033	14 45	35 42	4.7	2700	.85	99	End cycle Start cycle 3450	299 300 18		97.7	141.5	109.1	109.1	.1	.1	+12
0035	14 47	35 44	Shut Down			End cycle 300										

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ENGINEERING LABORATORIES

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RIG NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222PT-31 Rev. A

SERIAL NO. ___

PART NO. Z37500

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	77.3	.1	.2	+7°
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	4.7				[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	.2	.1	[illegible]
[illegible]	[illegible]	[illegible]	4.7				[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	77	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	.2	.1	0°
			4.7				[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	4.7				[illegible]	[illegible]								
							[illegible]	[illegible]								
							[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	77	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	.1	.1	[illegible]
							[illegible]	[illegible]								
							[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	77	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	.2	.1	[illegible]
			4.7				[illegible]	[illegible]								

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ENGINEERING LABORATORIES

SHEET 45 OF ___
DATE [illegible]
ENGINEER [illegible]
OPERATORS [illegible]

P.O. NO. G-7
TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST
W.P.I. NO. [illegible]
PLAN OF TEST NO. 222PT-31 Rev. A
SERIAL NO.
PART NO. 767500

Time	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	PSIG Lube Oil	PSIG EHV Supply	PSIG G/B Oil		#1 Clutch	#3 EHV Supply	#4 Lube Oil	#5 Shroud Temp.	MILS Vib. Vert.	MILS Vib. Horiz.	Blade Angle
			4.7				[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]					[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	4.7				[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	2	.2	[illegible]
[illegible]	[illegible]	[illegible]	4.7				[illegible]	[illegible]								
				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]
	[illegible]	[illegible]					[illegible]	[illegible]								
	[illegible]		[illegible]				[illegible]	[illegible]								

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RIG NO. G-7
TYPE OF TEST G.E. GCSEE ACTUATOR ENDURANCE TEST
W.P.I. NO. [illegible]
PLAN OF TEST NO. 222PT-31 Rev. A
SERIAL NO.
PART NO. 767500
SHEET [illegible] OF
DATE [illegible]
ENGINEER [illegible]
OPERATORS [illegible]

UNITS →						PSIG	PSIG	PSIG						MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		#1 Clutch	#3 EHV Supply	#4 Lube Oil	#5 Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
[illegible]	11	37	4.7	3168	177	99	3450	16.5		111°	121°	73°	74	.1	.2	+7°
						[illegible]	[illegible]	[illegible]								
						[illegible]	[illegible]	[illegible]								
1040	11	37				[illegible]	[illegible]	[illegible]								
						[illegible]	cycle	.334								
						[illegible]	cycle	.334								
						[illegible]	[illegible]	[illegible]								
[illegible]	11	37	4.7	3160	171	99	3450	16.5		114°	115°	73°	75°	.2	.2	+7°
						END	cycle	.335								
						START	cycle	.336								
[illegible]	11	37	4.7	3168	172	99	3450	16.5		118°	115°	72°	73°	.1	.2	+7°
						END	cycle	.336								
						START	cycle	.337								
						END	cycle	.337								
						START	cycle	.338								
1100	11	37	4.7	3168	177	99	3450	16.5		121°	112°	74°	74°	.1	.2	0°
						END	cycle	.338								
						START	cycle	.339								
						END	cycle	.339								
						START	cycle	.340								
1110	11	37	4.7	3168	178	99	3450	16.5		111°	111°	73°	74°	.1	.2	+7°
						END	cycle	.340								
						START	cycle	.341								
						END	cycle	.341								
						START	cycle	.342								
[illegible]	11	37	4.7	3160	176	99	3450	16.5		113°	112°	72°	[illegible]	.2	.2	+12°

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET [illegible] OF
DATE 12-[illegible]
ENGINEER [illegible]
OPERATORS [illegible]

RIG NO. G-7
TYPE OF TEST G.E. UCSEE ACTUATOR ENDURANCE TEST
W.P.I. NO. [illegible]
PLAN OF TEST NO. 222PT-31 Rev. A
SERIAL NO.
PART NO. 767500

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	3950	16.5		111°	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]		240	[illegible]	99	3900	16.5		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.2	[illegible]
[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	348								
[illegible]	[illegible]	[illegible]	4.7	108	[illegible]	[illegible]	3950	16.5		116°	[illegible]	77°	[illegible]	.1	.2	0°
						[illegible]	[illegible]	350								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	16.5		116°	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]
						[illegible]	[illegible]	[illegible]								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	[illegible]	16.5		114°	[illegible]	[illegible]	[illegible]	.1	.2	0°
						[illegible]	[illegible]	353								

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RIG NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222PT-31 Rev. A

SERIAL NO.

PART NO. 767500

SHEET [illegible] OF

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
						END	OPEN	[illegible]								
						START	OPEN	[illegible]								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	110	99	3450	11.5		110°	128°	95°	75°	.1	.2	[illegible]
						END	OPEN	[illegible]								
						START	OPEN	355								
						END	OPEN	[illegible]								
						START	OPEN	356								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	162	99	3450	11.5		117	128	99	76	.1	.2	[illegible]
						END	OPEN	356								
						START	OPEN	357								
						END	OPEN	[illegible]								
						START	OPEN	358								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	171	99	3450	11.5		115	128	96	76	.1	.2	[illegible]
						END	OPEN	358								
						START	OPEN	358								
						END	OPEN	359								
						START	OPEN	360								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	170	99	3450	11.5		112	132	[illegible]	75	.1	.2	[illegible]
						END	OPEN	[illegible]								
						START	OPEN	[illegible]								
						END	OPEN	[illegible]								
						START	OPEN	[illegible]		~~[illegible]~~	[illegible]	[illegible]	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	
[illegible]	[illegible]	[illegible]	4.7	[illegible]	172	99	3450	11.5		115	128	96	77	.1	.2	[illegible]
						END	OPEN	[illegible]								
						START	OPEN	363								
						END	OPEN	363								
						START	OPEN	364								

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SHEET 47 OF
DATE [illegible]
ENGINEER [illegible]
OPERATORS [illegible]

RIG NO. G-7
TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST
W.P.I. NO. [illegible]
PLAN OF TEST NO. 222PT-31 Rev. A
SERIAL NO.
PART NO. 767500

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
[illegible]	[illegible]	[illegible]	4.7	[illegible]	121	99	3450	11.2		111°	131°	[illegible]	[illegible]	.1	.2	77°
						END	CYCLE	364								
						START	CYCLE	365								
						END	CYCLE	365								
						START	CYCLE	366								
[illegible]	[illegible]	[illegible]	4.7	3468	110	99	3450	11.2		111	135°	95°	99°	.1	.2	-5°
						END	CYCLE	366								
						START	CYCLE	367								
						END	CYCLE	367								
						START	CYCLE	368								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	113	99	3450	11.2		113°	129°	96°	96°	.1	.2	[illegible]
						END	CYCLE	368								
						START	CYCLE	369								
						END	CYCLE	369								
						START	CYCLE	370								
[illegible]	[illegible]	11 02	4.7	[illegible]	121	99	3450	11.2		115°	131°	96°	95°	.1	.2	+7°
						END	CYCLE	370								
[illegible]	[illegible]	[illegible]	[illegible]													

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ENGINEERING LABORATORIES

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RIG NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222PT-31 Rev. A

SERIAL NO.

PART NO. 767500

SHEET [illegible] OF

DATE 12-15-[illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
	[illegible]	[illegible]		TORQUE AT [illegible] INPUT						[illegible]			[illegible]			
[illegible]	[illegible]	[illegible]	4.7	3700	[illegible]	99	3950	11.5		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.3	[illegible]
							[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	END / START CYCLE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
							END / START CYCLE	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	4.7				END / START CYCLE	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	3950	12.0		[illegible]	[illegible]	19.2	[illegible]	.1	.1	[illegible]
							END / START CYCLE	[illegible]	[illegible]							
							END / START CYCLE	[illegible]	[illegible]							
STOP [illegible]	[illegible]	[illegible]	4.7				END / START CYCLE	[illegible]	[illegible]	[illegible]				[illegible]		
START [illegible]	[illegible]	[illegible]	[illegible]	3700	[illegible]	99	START / 3950	12.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.2	.1	[illegible]
[illegible]	[illegible]	[illegible]					END / START CYCLE	[illegible]	[illegible]							
							END / START CYCLE	[illegible]	[illegible]							
							END / START CYCLE	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	11.5			[illegible]	[illegible]	[illegible]	.1	.1	-3°
							END / START CYCLE	[illegible]	[illegible]							

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WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET [illegible] OF

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

RIG NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

PLAN OF TEST NO. 222PT-31 Rev. A

W.P.I. NO. [illegible]

SERIAL NO.

PART NO. 767500

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
							[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
							[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
							[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	[illegible]							
							[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
							[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	4.7				[illegible]	[illegible]	[illegible]							
							[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]		4.7	[illegible]	[illegible]	99	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET ___ OF ___

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

RIG NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222PT-31 Rev. A

SERIAL NO.

PART NO. 767500

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
			4.7				[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	4.7				[illegible]	[illegible]	[illegible]							
							[illegible]	[illegible]	317							
		[illegible]					[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]							
			4.7	[illegible]	[illegible]	99	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	.1	.1	[illegible]
[illegible]	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]							
			TORQUE AT MANUAL INPUT 30-35 IN LBS													
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	3150	16.5		[illegible]	[illegible]	[illegible]	[illegible]	.2	.2	[illegible]
							[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	.1	[illegible]
							[illegible]	[illegible]	[illegible]							
			4.7				[illegible]	[illegible]	[illegible]							
							[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	.2	
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	[illegible]	16.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]

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WINDSOR LOCKS, CONNECTICUT • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET [illegible] OF

RIG NO. G-7
TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST
W.P.I. NO. [illegible]
PLAN OF TEST NO. 222PT-31 Rev. A
SERIAL NO.
PART NO. 767500
DATE [illegible]
ENGINEER [illegible]
OPERATORS [illegible]

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
[illegible]	[illegible]	[illegible]	4.7				[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	22	[illegible]	10.5		[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	39	[illegible]	10.5		[illegible]	[illegible]	[illegible]	[illegible]	.2	.3	-10°
[illegible]	1/2	[illegible]	4.7	[illegible]	[illegible]	22	[illegible]	10.5		[illegible]	[illegible]	[illegible]	[illegible]	.1	.2	-10°

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DIVISION OF UNITED AIRCRAFT CORPORATION
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LOG OF TEST
ENGINEERING LABORATORIES

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R.G NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222PT-31 Rev. A

SERIAL NO.

PART NO. 767500

SHEET [illegible] OF

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
							[illegible]	[illegible]	[illegible]							
		[illegible]	[illegible]				[illegible]	[illegible]	[illegible]							
[illegible]	1	[illegible]					[illegible]	[illegible]	#419							
							[illegible]	[illegible]	#420							
							[illegible]	[illegible]	#420							
													S. Hunt			
[illegible]	24	44	4.7	2740	.85	99	3500	18		123	94	53	49	.1	.1	+1.15
							Start	cycle	#421							
							End	cycle	#421							
							Start	cycle	#422							
							End	cycle	#422							
							Start	cycle	#423							
							End	cycle	#423							
							Start	cycle	#424							
18:25	24^17	45^20	4.7	2667	.85	99	End	cycle	#424	93	124	77	77	.1	.1	+8.5
							Start	cycle	#425							
							End	cycle	#425							
							Start	cycle	#426							
							End	cycle	#426							
							Start	cycle	#427							
							End	cycle	#427							
							Start	cycle	#428							
18:55	24^37	45^40	4.7	2408	.85	99	3500 End	cycle	#428	93	120	82	79	.1	.1	-4.0
							Start	cycle	#429							
							End	cycle	#429							

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ENGINEERING LABORATORIES

SHEET 55 OF

DATE 12-18-75

ENGINEER D. [illegible]

OPERATORS S. Hunt

RIG NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

PLAN OF TEST NO. 222PT-31 Rev. A

W.P.I. NO. 779-103-A03 B

SERIAL NO.

PART NO. 767500

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
									START cycle #130							
1900	24^{41}	115^{25}	4.7						END cycle #130							
									START cycle #131							
1905	24^{41}	115^{30}		3068	.85	99	3500		END cycle #131	95	127	82	78	.1	.1	+6.5
									START cycle #132							
									END cycle #132							
									START cycle #133							
Stop 1915	24^{57}	115^{40}							END cycle #133							
Start 1950	24^{57}	115^{40}	4.7	2700	.85	99	3500	18		122	96	55	51	.1	.1	+12
									START cycle #134							
									END cycle #134							
									START cycle #135							
									END cycle #135							
									START cycle #136							
2000	25^{07}	115^{50}	4.7	3068	.85	99	3500		END cycle #136	95	126	74	73	.1	.1	+3
									START cycle #137							
									END cycle #137							
									START cycle #138							
									END cycle #138							
									START cycle #139							
2010	25^{17}	116^{00}	4.7	3068	.85	99	3500		END cycle #139	98	123	77	76	.1	.1	-1.0
									START cycle #140							
									END cycle #140							
									START cycle #141							
									END cycle #141							
									START cycle #142							
2020	25^{27}	116^{10}	4.7	3068	.85	99	3500		END cycle #142	94	129	77	76	.1	.15	+3
									START cycle #143							
									END cycle #143							
									START cycle #144							
									END cycle #144							

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ENGINEERING LABORATORIES

SHEET 56 OF

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RIG NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

W.P.I. NO. 164 003-1138

PLAN OF TEST NO. 222PT-31 Rev. A

SERIAL NO.

PART NO. 767500

DATE 12-15-75

ENGINEER D. Nelson

OPERATORS Gilbert

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
								Start Cycle	#445							
[illegible]	25^{37}	46^{35}	4.7	2700	.85	99	3500	End Cycle	#445	[illegible]	[illegible]	81	77	.1	.1	[illegible]
								Start Cycle	#446							
								End Cycle	#446							
								Start Cycle	#447							
								End Cycle	#447							
								Start Cycle	#448							
2010	25^{41}	46^{40}	4.7	3065	.85	99	3500	End Cycle	#448	97	131	82	76	.1	.1	+5
								Start Cycle	#449							
								End Cycle	#449							
								Start Cycle	#450							
								End Cycle	#450							
								Start Cycle	#451							
[illegible]	$25^{[illegible]}$	$46^{4[illegible]}$	4.7	3108	.85	99	3500	End Cycle	#451	97	[illegible]	79	76	.1	.1	-7
								Start Cycle	#452							
								End Cycle	#452							
								Start Cycle	#453							
								End Cycle	#453							
								Start Cycle	#454							
2105	26^{12}	46^{55}	4.7	2700	.85	99	3500	End Cycle	#454	96	131	81	76	.1	.1	-100
								Start Cycle	#455							
								End Cycle	#455							
								Start Cycle	#456							
								End Cycle	#456							
								Start Cycle	#457							
2115	$26^{[illegible]}$	47^{05}	4.7	3068	.85	99	3500	End Cycle	#457	97	133	80	76	.1	.1	+8
								Start Cycle	#458							
								End Cycle	#458							
								Start Cycle	#459							
								End Cycle	#459							
								Start Cycle	#460							
2125	$26^{[illegible]}$	47^{13}	4.7	2700	.85	99	3500	End Cycle	#460	97	127	80	74	.1	.1	-100

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LOG OF TEST
ENGINEERING LABORATORIES

DATE 12-15-75 SHEET 57 OF ___
ENGINEER [illegible]
OPERATORS [illegible]

P.O. NO. G-7
TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST
W.P.I. NO. [illegible]
PLAN OF TEST NO. 222PT-31 Rev. A
SERIAL NO.
PART NO 767500

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
									Start cycle #461 End cycle #461 Start cycle #462							
2125	26 15	47 25	4.7	3068	.85	99	3500		End cycle #462	97	133	81	75	.1	.1	+3
									Start cycle #463 End cycle #463 Start cycle #464							
2145	26	47	change paper in Sanborn						End cycle #464							
2200	26	47 55	4.7	3700	.85	99	3500	18		109	104	57	57	.1	.1	+12
									Start cycle #465 End cycle #465 Start cycle #466 End cycle #466 Start cycle #467							
2230	27 22	47 75	4.7	3168	.85	99	3500		End cycle #467	104	133	80	74	.1	.1	-6
									Start cycle #468 End cycle #468 Start cycle #469 End cycle #467 Start cycle #470							
2245	27 77	48 00	4.7	3068	.85	99	3500		End cycle #470	100	132	77	75	.1	.1	+3
									Start cycle #471 End cycle #471 Start cycle #472 End cycle #472 Start cycle #473							
2315	27	48 10	4.7	2100	.85	99	3500		End cycle #473	99	121	78	75	.1	.1	-10
									Start cycle #474 End cycle #474 Start cycle #475 End cycle #475							

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SHEET 58 OF
DATE 12-18-75
ENGINEER D. Nelson
OPERATORS S. Hurd

RIG NO. G-7
TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST
W.P.I. NO. 117-CC3-A00 B
PLAN OF TEST NO. 222PT-31 Rev. A
SERIAL NO.
PART NO. 767500

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
2255	27:37	118:20	4.7	3406	.85	99	3500		Start Cycle #476 End Cycle #476	101	123	78	74	.1	.1	160
									Start Cycle #477 End Cycle #477							
									Start Cycle #478 End Cycle #478							
2305	27:47	118:30	4.7	3068	.85	99	3500		Start Cycle #479 End Cycle #479	99	135	78	75	.1	.1	47
									Start Cycle #480 End Cycle #480							
									Start Cycle #481 End Cycle #481							
2320	28:02	118:45	4.7	2700	.85	99	3500		Start Cycle #482 End Cycle #482	99	124	78	75	.1	.1	160
									Start Cycle #483 End Cycle #483							
									Start Cycle #484 End Cycle #484							
2330	28:12	119:00	4.7	3408	.85	99	3500		Start Cycle #485 End Cycle #485	101	137	76	74	.1	.1	160
STOP 2335	28:17	119:05														

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. G-7

TYPE OF TEST G.E. OCSEE ACTUATOR ENDURANCE TEST

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222PT-31 Rev. A

SERIAL NO.

PART NO. 767500

SHEET [illegible] OF

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

Time	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	PSIG Lube Oil	PSIG EHV Supply	PSIG G/B Oil		#1 Clutch	#3 EHV Supply	#4 Lube Oil	#5 Shroud Temp.	MILS Vib. Vert.	MILS Vib. Horiz.	Deg. Blade Angle
[illegible]	[illegible]	[illegible]	TORQUE		AT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	11.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
							START	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]					START	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	11.7													
							START	[illegible]	[illegible]							
							START	[illegible]	[illegible]							
							START	[illegible]	4490							
[illegible]	[illegible]	[illegible]	11.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
							END	CYCLE	[illegible]							
							START	CYCLE	[illegible]							
[illegible]	[illegible]	[illegible]					END	CYCLE	4492							
							START	CYCLE	4493							
							END	CYCLE	4494							
[illegible]	[illegible]	[illegible]					START	CYCLE	[illegible]							
							END	CYCLE	4495							
							START	CYCLE	4496							
							END	CYCLE	[illegible]							

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ENGINEERING LABORATORIES

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RIG NO. G-7

TYPE OF TEST G.E. UCSEE ACTUATOR ENDURANCE TEST

PLAN OF TEST NO. 222PT-31 Rev. A

W.P.I. NO. [illegible]

SERIAL NO.

PART NO 767500

SHEET 60 OF

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil		Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
								Start Cycle #497								
								End Cycle #497								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	[illegible]	[illegible]	17.5		[illegible]	[illegible]	[illegible]	[illegible]	1	1	[illegible]
								End Cycle #497								
								Start Cycle #498								
								End Cycle #498								
								Start Cycle #499								
								End Cycle #499								
								Start Cycle #500								
11 [illegible]	[illegible]	[illegible]	4.7					End Cycle #500								
								Start Cycle #501								
								End Cycle #501								
								Start Cycle 502								
[illegible]	[illegible]	[illegible]	4.7	[illegible]	[illegible]	99	[illegible]	17.5		[illegible]	[illegible]	[illegible]	[illegible]	2	1	[illegible]
								Start Cycle #502								
								End Cycle #502								
11 10	[illegible]	[illegible]	4.1					Start Cycle #503								
								End Cycle 503								
								Start Cycle #504								
								End Cycle #504								
11 [illegible]	[illegible]	[illegible]						Start Cycle #505								
								End Cycle #505								
			End of 500 Cycle Test													

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Division of United Aircraft Corporation

Windsor Locks, Connecticut • U.S.A.

LOG OF TEST
ENGINEERING LABORATORIES

SHEET 1 OF ___

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

RIG NO. ___

TYPE OF TEST [illegible] Test

PLAN OF TEST NO. 322 PT-31 Rev. A

W.P.I. NO. [illegible]

SERIAL NO. ___

PART NO. [illegible]

UNITS → / TIME	[illegible]	[illegible]	Time	Eng RPM	Lube Flow	Eng Lube Oil	Eng CAV Supply	Eng C/B Oil		#1 Clutch	#3 CAV Supply	#4 Lube Oil	#5 [illegible]	Mils V.G Vert.	Mils Vib Horz	[illegible]
[illegible]	[illegible]	[illegible]	411	2700	[illegible]	78	[illegible]	13.5		[illegible]	151	[illegible]	[illegible]	.3	.1	0
[illegible]	[illegible]	[illegible]	[illegible]													
[illegible]	[illegible]	[illegible]	411	700	[illegible]	77	3500	12.0		115.0	[illegible]	119.5	111	.2	.1	0
[illegible]	[illegible]	[illegible]														
[illegible]	[illegible]	[illegible]	411	3008	[illegible]	79	[illegible]	15.0		113.0	114.2	[illegible]	[illegible]	[illegible]	.1	[illegible]
[illegible]	[illegible]	[illegible]	411	3008	[illegible]	79	3500	15.5		118.0	139.8	[illegible]	[illegible]	.1	.3	-.3
[illegible]	[illegible]	[illegible]														
[illegible]	[illegible]	[illegible]	411.2	2920	[illegible]	82	[illegible]	15.5		104.2	[illegible]	[illegible]	115.0	.1	.3	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]													

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ENGINEERING LABORATORIES

SHEET 1 OF

194

RIG NO. G-7

TYPE OF TEST Calibration [illegible] vs. Cwt Angle

W.P.I. NO. 1[illegible]-C03 AC2B

PLAN OF TEST NO. 222 PT-31 Rev A

SERIAL NO.

PART NO. [illegible]

DATE 12-30-75

ENGINEER D. Leiskun[illegible]

OPERATORS E. Shunk[illegible]

UNITS ► TIME	[illegible] Angle	LVDT	CWT ∡	CKM ∡
	+11°	2.1	+36.3	+2.5°
	+8°	2.0	+33.3	5.1
	+4	1.85	+29.2	8.7
	0	1.67	+24.7	13.3
	-4	1.5	+20.3	17.6
	-8	1.35	+16.7	21.5
	-15	1.08	+9.9	28.4
	-25	.70	+0.5	37.8
	-45	-.10	-20.1	55.4
	-65	-.87	-49.2	77.2
	-75	-1.53	-69.1	93.6
	-77	-1.64	-72.2	96.3
	-103	-1.77	-76.7	99.5

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ENGINEERING LABORATORIES

SHEET 8 1 OF

DATE 12-30-75

ENGINEER D. [illegible]

OPERATORS

RIG NO. [illegible] 7

TYPE OF TEST [illegible] Position Accuracy

W.P.I. NO. [illegible] 09- AC3B

PLAN OF TEST NO. 222 PT-31 [illegible]

SERIAL NO.

PART NO. [illegible]

UNITS → / TIME	[illegible]	[illegible]	Press.	Eng. RPM	Lube Flow	PSIG Lube Oil	PSIG FHV Supply	PSIG C/B Cil	#1 Clutch	#3 FHV Supply	#4 Lube Oil	#5 [illegible] Temp	Mils Vib [illegible]	Mils [illegible]	LVDT [illegible]	Act. [illegible]
[illegible]	[illegible]	[illegible]	4.41	2700	.8568	99	2100	17.0	[illegible]	[illegible]	236°	[illegible]	.2	.3	[illegible]	[illegible]
				2700	.8568	99	2100	17.0	233°	[illegible]	[illegible]	[illegible]	.2	.3	-3	-2.2
				2700	.8568	99	2100	17.0					.2	.3	0	[illegible]
				2700									.2	[illegible]	[illegible]	[illegible]
				2700			2100	17.0					.2	.3	[illegible]	[illegible]
				2700									.2	.3	+20	+8.0
				2700									.2	.3	[illegible]	[illegible]
				2700									.2	.3	[illegible]	[illegible]
				2700									.2	.3	-10	[illegible]
				2700									.2	.3	+12.0	[illegible]
			4.42	2700	.8568	99	3100	18.5					.2	.3	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	4.42	3068	.8568	99	3100	18.5					.2	.3	-3.0	[illegible]
			4.42	3068	.8568	99	3100	18.5					.2	.3	0	.8
			4.42	3068									.2	.3	+2.0	[illegible]
			4.42	3068									.2	.3	-5.0	[illegible]
			4.42	3068							106.3	[illegible]	.2	.3	[illegible]	[illegible]

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ENGINEERING LABORATORIES

SHEET 3 OF ___

DATE 12 30 72
ENGINEER D. [illegible]
OPERATORS E. [illegible]

RIG NO. [illegible]
TYPE OF TEST [illegible] Angle Position Accuracy
W.P.I. NO. 109 - C C [illegible] - AC2-B
PLAN OF TEST NO. 2237C-31 Rev A
SERIAL NO.
PART NO. [illegible]

UNITS → TIME	Test Time	Total Time	Torq.	Prop RPM	Lube Flow	PSIG Lube Oil	PSIG EHV Supply	PSIG G/B Oil	#1 Clutch	#3 EHV Supply	#4 Lube Oil	#5 [illegible]	Hub Vib. Vert.	Hub Vib. Horiz.	Blade Angle	Act. Angle
			4.4 [illegible]	3[illegible]	.85GB	99	[illegible]	16.5					.2	3	+9[illegible]	[illegible]
			4.4 [illegible]	3[illegible]	.85GB	99	[illegible]	16.5					.2	3	[illegible]	[illegible]
			4.4 [illegible]	3[illegible]	.85GB	99	[illegible]	16.5					.2	.3	-100	-100
			44.[illegible]	3[illegible]	.85GB	99	3[illegible]	16.5	109.4	112.0	111.9	111.1	.2	.3	12.0	[illegible]
Stop 11[illegible]	31 [illegible]	52 [illegible]	4.5.4	3408	.85GB	99	34.0	18.5	38.7	115.8	116.9	100.8	.2	3	0	[illegible]
Start 1[illegible]	31 32	52 35	4.5.4	3408	.85GB	99	3[illegible]									
[illegible] 15 20	31 47	52 35		Min	Blade Angle	Change	0.2									
[illegible] 15 25	31 47	52 [illegible]	4.5.4	3408	.85GB	99	3[illegible]	16.5	109.4	120.4	12[illegible]	110.[illegible]	.2	.3		
[illegible] 15 [illegible]	31 [illegible]	52 40		Repaint	Fan	Face	Surface									

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ENGINEERING LABORATORIES

SHEET 1 OF ___

RIG NO. G-7
TYPE OF TEST Blade Angle Position Accuracy
W.P.I. NO. [illegible]
PLAN OF TEST NO. 222 PT-31 Rev A
SERIAL NO.
PART NO. 763500
DATE 12-31-75
ENGINEER D. [illegible]
OPERATORS F. Saunders

TIME	Test Time	Total Time	Para.	Rig RPM	Lube Flow	PSIG Lube Oil	PSIG EHV Supply	PSIG G/B Oil	#1 Clutch	#3 EHV Servo	#4 Lube Oil	#5 Water Temp	Mils Vib Vert	Mils Vib Horz	LVDT Blade Angle	Act. Blade Angle
Start 0850	31 52	51 45	4.4.1	2700	.85 GG	99	3400	18.7	113.0°	52.0	71.1	69.3°	.1	.3	+5.0	
Stop [illegible]	32	55		To Touch up white Ring on Painter												
Start 0940	32	55	4.4.2	3068	.95 GTS	99	3450	18.5	107.0°	89.5	88.0	88.0°	.2	.3	+12.0	+13.0°
				3068	.95 GTS	99	3450	18.5					.2	.2	+7.0°	+10.5°
				3068	.95 GTS	99	3450	18.5					.2	.1	+2.0	+8.0
				3068	.95 GTS	99	3450	18.5		101.0	98.1	102.4°	.1	.1	+5.0°	+6.0°
				3068									.1	.1	0°	[illegible]
				3068			3450						.1	.1	-3.0°	-2.0
				3068			3450						.1	.1	-100.0°	-92.5
				3068			3450						.1	.1	-3.0	-2.5°
				[illegible]			3450						.1	.1	0°	-1.0°
				3068			3450						.1	.1	+5.0°	+5.5°
				3068			3450						.1	.1	+7.0	+8.0°
				3068			3450						.1	.1	+5.0	+10.0
			4.4.2	3068			3410						.1	.1	+12.0	+12.0°

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ENGINEERING LABORATORIES

SHEET 5 OF ___

RIG NO. C-4

TYPE OF TEST Blade Angle Position Accuracy

W.P.I. NO. [illegible] CO3 - [illegible]

PLAN OF TEST NO. 322 PT-31 [illegible]

SERIAL NO. ___

PART NO. [illegible]

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS → TIME	Tot. Time	Tot. Run Time	Pack	Rig RPM	Lube Flow	PSIG Lube Oil	PSIG FHV Supply	PSIG G.B. Oil	#1 Clutch	#3 FHV Supply	#4 Lube Oil	#5 [illegible]	Mils Vib. Vert.	Mils Vib. Horz.	LVDT Blade Angle	Act. [illegible] Rate
			451	3100	[illegible]	99		18.5	105.0°	123.0°	[illegible]	[illegible]	.1	.1	+12.0	
[illegible]	[illegible]	[illegible]		3108	.55 gpm	99		18.5					.1	.1	0	
[illegible]	[illegible]	[illegible]		3100	.55 gpm	99		18.5					.1	.1	-100.0	
[illegible]	[illegible]	[illegible]		3100	.55 gpm	99		18.5					.1	.1	+12.0	
				3108	.55 gpm	99		18.5					.1	.2	0°	
				3068	.55 gpm	99		18.5	101.7°	109.1	138.5	134.6°	.1	.1	77°	
				3065	.55 gpm	99		18.5					.1	.1	+75°	
				3068	.55 gpm	99		18.5					.1	.1	-100.0	
[illegible]				3100	.55 gpm	99		18.5					.1	.1	-100.0	
[illegible]	[illegible]	[illegible]		Rig Engineer - Check Data												

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 1 OF

RIG NO. G-[illegible]
TYPE OF TEST [illegible] Pressure Vs Flow
W.P.I. NO. [illegible]
PLAN OF TEST NO. I O C
SERIAL NO.
PART NO.
DATE 1-[illegible]
ENGINEER D. [illegible]
OPERATORS [illegible]

UNITS →	PSIG PRESS	FLOW OZ/Min	°F OIL TEMP
TIME			
	11	9	83
	20	~~11.5~~ 14.25	110
	30	18	125
	40	21.75	129
	50	24.25	133
	60	26.75	133
	70	29	134
	80	31	134

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LOG OF TEST
ENGINEERING LABORATORIES

SET 1 OF

200

RIG NO. 12-7

TYPE OF TEST [illegible] ANGLE CAL

W.P.I. NO. [illegible]

PLAN OF TEST NO. 333PT-38

SERIAL NO. 1

PART NO. [illegible]

DATE 12-5-71

ENGINEER [illegible]

OPERATORS [illegible]

UNITS →				Vts		
TIME	Cult °F	F	[illegible]	[illegible]		exc Volts
	-98.7	-123.7	-2.320	-2.349		5.667
	-90.5	-115.5	-2.142	-2.116		travel limit switch
	-80	-105	-1.817	-1.792		
	-70	-95	-1.483	-1.460		
	-60	-85	-1.148	-1.127		
	-50	-75	-.812	-.832		
	-40	-65	-.576	-.517		
	-30	-55	-.212	-.228		
	-20	-45	+.069	+.092		
	-10	-35	+.388	+.404		
	0	-25	+.743	+.758		
	+10	-15	+1.113	+1.136		
	+15	-10	+1.347	+1.361		
	+17	-8	+1.436	+1.450		
	+19	-6	+1.[illegible]	+1.534		
	+21	-4	+1.594	+1.608		

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ENGINEERING LABORATORIES

SHEET 3 OF ___

RIG NO. [illegible]

TYPE OF TEST [illegible]

W.P.I. NO. [illegible]

PLAN OF TEST NO. [illegible]

SERIAL NO. 1

PART NO. [illegible]

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS →					
TIME	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	+6	[illegible]	1.983	
	[illegible]	[illegible]	+2.047	+2.059	
	[illegible]	[illegible]	+2.109	+2.121	
	[illegible]	+12	+2.186	+2.200	
	+55.3	+13.3	[illegible]	+2.317	travel limit switch
	[illegible]	+12	[illegible]	+2.300	

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. G-7
TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST
W.P.I. NO. [illegible]
PLAN OF TEST NO. 222PT-38 Rev. A
SERIAL NO.
PART NO. 767500

SHEET 1 OF
DATE 2-6-76
ENGINEER [illegible]
OPERATORS [illegible]

TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	PSIG Lube Oil	PSIG EHV Supply	PSIG G/B Oil		#1 Clutch	#3 EHV Supply	#4 Lube Oil	#5 Shroud Temp.	MILS Vib. Vert.	MILS Vib. Horiz.	Deg. Blade Angle
[illegible]	0	[illegible]	[illegible]	2700	[illegible]	18	[illegible]	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.3	[illegible]
									[illegible]							
[illegible] 10	Shut down - hydraulic pump dropped out															
1 [illegible]	1	[illegible]	3.6	2700	9565	18	3300	18		111.4	121.5	107.6	65.3	.1	.2	9°
[illegible]	[illegible]	[illegible]	[illegible]													
					2-7-76											
[illegible]	1	[illegible]	3.6	2700	9565	18	2400	18	[illegible]	112.0	71.4	[illegible]	55.3	.2	.3	12
[illegible]	[illegible]			2700	9565	18			[illegible]	[illegible]						[illegible]
[illegible]	1	[illegible]	[illegible]	2700	9565	18	2280	18		114.6	124	51.7	55.7	.1	.2	12°
[illegible]	1	[illegible]	[illegible]	[illegible]												
[illegible]	1	[illegible]	[illegible]	2700	9565	18	3300	18	[illegible]	110.1	[illegible]	110.0	70.0	.1	.2	12°
									[illegible]							
[illegible]	[illegible]	[illegible]							[illegible]							
[illegible]	[illegible]	12	3.6	2700	9565	18	3100	18	[illegible]	111.4	75°	116	73°	.1	.2	12°

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 2 OF ___
DATE [illegible]
ENGINEER [illegible]
OPERATORS [illegible]

RIG NO. G-7
TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST
W.P.I. NO. [illegible]
PLAN OF TEST NO. 222PT-3B Rev. A
SERIAL NO.
PART NO. 767500

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil	Cycles	Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
[illegible]	27 42	50 30	3.6	[illegible]	[illegible]	18	[illegible]	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] SHUTDOWN TO CHECK HYD PUMPS													
[illegible]	12	[illegible]	3.6	2100	[illegible]	58	3100	18	[illegible]	110°	[illegible]	[illegible]	87°	.1	.2	112
[illegible]		[illegible]	[illegible]						[illegible]							
[illegible]	[illegible]	[illegible]	[illegible]	2868	[illegible]	58	3100	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]
[illegible]	[illegible]		[illegible] BUTTERFLIES						[illegible]	[illegible]						
					2-10-76 Tues											
[illegible]	[illegible]	[illegible]	3.6	2400	[illegible]	100	3750	16	[illegible]	[illegible]	105	220	54	.1	.25	[illegible]
1115	1	[illegible]	3.6	[illegible]	[illegible]	48	[illegible]	16	[illegible]	[illegible]	120	[illegible]	[illegible]	.1	.2	[illegible]

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SHEET 3 OF

RIG NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222PT-38

SERIAL NO.

PART NO. 763500

DATE [illegible]

ENGINEER [illegible]

OPERATORS [illegible]

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/D Oil	Cycles	Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
1130	31	51	3.6	[illegible]	[illegible]	28	3400	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]
[illegible]	[illegible]	[illegible]	3.6	3400	[illegible]	28	3400	18	[illegible]	[illegible]	[illegible]	[illegible]	125.5	.1	.2	[illegible]
			3.6	[illegible]	[illegible]	28	3400	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]
[illegible]	[illegible]	[illegible]	3.6	3400	[illegible]	28	3400	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	.1	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	28	3400	18	[illegible]	1042	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]
[illegible]	[illegible]	56	[illegible]	[illegible]	[illegible]	28	3400	18	[illegible]	[illegible]	[illegible]	[illegible]	1331	.1	.1	[illegible]

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 1 OF

RIG NO. G-7

TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222PT-38

SERIAL NO.

PART NO. 763500

DATE [illegible]-76

ENGINEER [illegible]

OPERATORS [illegible]

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil	CYCLES	Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
			3.6						START 37							
									END 37							
									START 38							
									END 38							
									START 39							
									END 39							
									START 40							
[illegible]	[illegible]	56 [illegible]	3.6	[illegible]	[illegible]	98	3400	18	END 40	[illegible]	110.6	[illegible]	133.[illegible]	.1	.15	[illegible]
									START 41							
									END 41							
									START 42							
									END 42							
									START 43							
									END 43							
									START 44							
									END 44							
									START 45							
13:25	36 [illegible]	56 35	3.6	30.68	.8595	78	3400	18	END 45	[illegible]	[illegible]	150	134.3	.1	.1	[illegible]
									START 46							
									END 46							
									START 47							
									END 47							
									START 48							
									END 48							
									START 49							
									END 49							
									START 50							
[illegible]	36 [illegible]	57 00	3.6	[illegible]	[illegible]	98	3400	18	END 50	[illegible]	[illegible]	150.8	[illegible]	.1	[illegible]	[illegible]
									START 51							
									END 51							
									START 52							
1400	[illegible]	57 10							END 52							

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LOG OF TEST
ENGINEERING LABORATORIES

SHEET 5 OF
DATE [illegible]
ENGINEER [illegible]
OPERATORS [illegible]

RIG NO. G-7
TYPE OF TEST G.E. QCSEE ACTUATOR ENDURANCE TEST
W.P.I. NO. [illegible]
PLAN OF TEST NO. 222PT-38
SERIAL NO.
PART NO. 763500

UNITS →						PSIG	PSIG	PSIG		#1	#3	#4	#5	MILS	MILS	Deg.
TIME	Test Time	Total Time	Para.	Rig R.P.M.	Lube Flow	Lube Oil	EHV Supply	G/B Oil	[illegible]	Clutch	EHV Supply	Lube Oil	Shroud Temp.	Vib. Vert.	Vib. Horiz.	Blade Angle
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	[illegible]	[illegible]
									[illegible]							
									[illegible]							
									[illegible]							
									[illegible]							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3400	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.1	.2	[illegible]
									END [illegible]							
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.95515	18	3400	18	[illegible]	[illegible]	[illegible]	151.9	140.0	.1	.2	[illegible]
			TORQUE AT MANUAL INPUT 30 TO 35 INCH/LBS. BOTH WAYS													

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. G-7 SHEET ___ OF ___
TYPE OF TEST [illegible] ACCURACY DATE [illegible]
W.P.I. NO. [illegible] PLAN OF TEST NO. [illegible] ENGINEER [illegible]
SERIAL NO. ___ PART NO. [illegible] OPERATORS [illegible]

UNITS →	[illegible]	.001"													
TIME	[illegible]	[illegible]			LVDT	[illegible] ANGLE	DISP [illegible]			LVDT	[illegible]	DISP [illegible]			
	[illegible]	.75[illegible]			1.791		[illegible]			1.7[illegible]		.3[illegible]5			
[illegible]		.72[illegible]			1.798		.253			1.72[illegible]		.330			
[illegible]		.69[illegible]			1.805		.225			1.715		.4[illegible]			
[illegible]		.66[illegible]			1.813		.189			1.70[illegible]		.457			
[illegible]		.638			1.820	+2.0	.160			1.7[illegible]		.478			
[illegible]		.61[illegible]			1.813		.160			1.693		.515			
[illegible]		.58[illegible]			1.805		.160			1.6[illegible]		.5[illegible]			
[illegible]		.54[illegible]			1.798		.160			1.678		.573			
[illegible]		.5[illegible]			1.791		.160			1.670	-[illegible]	.606			
[illegible]		.4[illegible]			1.784		.158								
[illegible]	0	.4[illegible]			1.776		.183								
[illegible]		.4[illegible]			1.768		.213								
[illegible]		.4[illegible]			1.760		.245								
[illegible]		.3[illegible]			1.753		.276								
[illegible]		.3[illegible]			1.745	0	.306								
[illegible]		[illegible]			1.738		.332								

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LOG OF TEST
ENGINEERING LABORATORIES

RIG NO. [illegible] 7

TYPE OF TEST [illegible] Response Check

W.P.I. NO. [illegible]

PLAN OF TEST NO. 222 PT 38

SERIAL NO.

PART NO. 763[illegible]

SHEET 1 OF

DATE [illegible]

ENGINEER D. [illegible]

OPERATORS E. [illegible]

UNITS →	Test	Total			Lube	PSIG	PSIG	PSIG	°F	°F	°F	LVDT	Cwic
TIME	Time	Time	[illegible]	RPM	Flow	Lube Oil	C/B Load	ENV Supply	ENV Supply	Lube Oil	Shaft Temp	Voltage	Angle
			Made Static Blade Angle Check With Eng.									[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25	120	300	105°	[illegible]	[illegible]	[illegible]	[illegible]°
				[illegible]	[illegible]	18	14.0	320	124°	[illegible]	[illegible]		
[illegible]	[illegible]	58		For Engineer D. Smith									
				[illegible] 16-76									
			[illegible] Pumps. Set Pressures For Static Frequency Response Test										
			[illegible] Test With Eng. Smith - Data Recorded on Sanborn. Removed										
			Control + No Back Assembly With Ass'y Man For Inspection.										

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APPENDIX E

TEST CHRONOLOGY

TEST CHRONOLOGY

11-4-75	Started installation of actuator on rig.
11-5-75 & 11-6-75	Continued installation of actuator on rig.
11-7-75	Checked torque required to change pitch at wave generator. Appears high.
11-8-75	Removed actuator from disc. Retorqued blade retaining nuts to approximately equal twisting torques for each blade. Reinstalled actuator. Torque at wave generator now $\approx$150 inch pounds. Continued assembly.
11-10-75	Completed installation. Ran LVDT calibrations and lubrication flow check. Found flex shaft leaks.
11-11-75	Sealed up leaks in flex shaft. Started running travel limit switch tests. After several stops, actuator would not move. Partial disassembly revealed no back output shaft fractured.
11-12-75 thru 11-19-75	Removed actuator from rig for inspection, and reinstalled on rig with repaired (welded) no back output shaft. Torque at wave generator to change pitch 140 inch pounds and at manual input $\approx$45 inch pounds.
11-20-75	Attempts to run stopped by oil leaks at rig drive flange and water leaks at rig clutch. Removed actuator and disc from rig. Reworked oil drain holes in rig drive flange, and revised drive flange seal and clutch cooling water plumbing.

TEST CHRONOLOGY (continued)

11-21-75	Reinstalled disc and actuator. Oil leaks o.k., but clutch cooling water marginal. Could not get fan speed above 2750 rpm with blade angle as circuit breakers trip.
11-22-75	Exploring rig power problem.
11-24-75 thru 11-26-75	Fabricated shroud to enclose blades. Check run shows power problem solved.
11-28-75	Ran performance tests and 15 flight cycles with reduced pitch change rate.
11-29-75	Ran 31 flight cycles (total 46) and max pitch change rate tests.
12-1-75	Started disassembly for inspection. Found no-back output shaft fractured.
12-2-75 thru 12-5-75	Continued inspection and reassembly with new output shaft. Hydraulic motor bevel gear mesh pattern high. Reshimmed closer into mesh. Trunnion roller pattern on cam is high on one side of track, low on other. Torque to change pitch at manual input $\approx$40 inch pounds.
12-6-75	Ran 14 flight cycles (total 60). Inspected no-back hardware, o.k.
12-8-75	Ran 71 flight cycles (total 131).
12-9-75	Ran 24 flight cycles (total 155). Inspected no-back hardware, o.k.. Ran 33 flight cycles (total 188).

TEST CHRONOLOGY (continued)

12-10-75	Ran 52 flight cycles (total 240). Torque to change pitch at manual input now 35-40 inch pounds.
12-15-75	Ran part of frequency response testing and 60 flight cycles (total 300).
12-16-75	Inspected no-back hardware, o.k. Reworked no-back output shaft to reduce stress concentrations and shot peened it in web area.
12-17-75	Reassembled and ran 70 flight cycles (total 370).
12-18-75	Ran 115 flight cycles (total 485).
12-19-75	Ran 20 flight cycles (total 505). Disassembled no-back for inspection. Output shaft fractured in one web.
12-29-75	Reassembled and ran rotating frequency response test.
12-30-75	Ran positioning accuracy and minimum blade angle change tests.
12-31-75	Re-ran travel limit switch, performance, positioning accuracy, and static frequency response tests.
1-2-76 thru 1-7-76	Complete disassembly and inspection including magnaflux and zyglo. Hydraulic motor bevel gear mesh showed pitting and scoring. One hydraulic motor damaged during disassembly. No-back output shaft was fractured. All other magnaflux and zyglo o.k.

<u>TEST CHRONOLOGY</u> (continued)

1-8-76 thru 1-12-76	Reassembled beta regulator with one new motor, new bevel gear set, and reworked feedback shaft to provide positive bevel gear mesh lubrication.
1-13-76	Reassembled differential gear train. Beta regulator at inspection for installation dimension check.
1-14-76	Ran lubrication flow versus pressure test on beta regulator.
1-15-76	Beta regulator to shipping. Reassembled no-back with new spring and new output shaft.
1-16-76	Fitting spring to drum.
1-19-76	Started actuator installation in rig. Rear housing fractured during assembly.
1-20-76 thru 1-30-76	Repair of rear housing. Ran static deflection tests on snubber.
2-2-76 thru	Reassembly on rig. Actuator has new no-back spring and output shaft, new flex shaft, and snubber. New flex shaft has slight leak.
2-5-76	Ran an LVDT calibration and maximum pitch change rate testing. Inspected no-back hardware, o.k.

TEST CHRONOLOGY) (continued)

2-6-76	Reassembled actuator and attempted to run flight cycles. Had trouble with controller and pumps which supply pitch change fluid. Ran 3 flight cycles.
2-7-76	Ran 12 flight cycles (total 15). Had trouble with pitch change fluid pumps.
2-9-76	Installed an accumulator in the pitch change fluid supply system.
2-10-76	Ran 45 flight cycles (total 60).
2-11-76	Attempted to run static frequency response test. No response at $\pm$ 4 ma input to servo valve.
2-12-76	Disassembled regulator. Found one hydraulic motor (new one) has heavy wear on housing at drive gear face. Dimensional checks show nothing. Started rework necessary to obtain new motor.
2-13-76	Reassembled regulator and ran travel limit switch tests.
2-14-76	Installed new motor in regulator. Actuator responds to $\pm$ 4 ma inputs to servo valve. Ran blade angle accuracy and performance tests.
2-16-76	Ran static frequency response test. Started disassembly.
2-17-76	Hardware inspection revealed that flex shaft had been overtorqued. All other hardware o.k.

APPENDIX F
REFERENCES

REFERENCE LIST

HSPC 74A14	QCSEE Variable Pitch Fan System Proposal
SP 08A74	QCSEE Variable Pitch Fan Pitch Change System
NASA CR-134852	Hamilton Standard Cam/Harmonic Drive Variable Pitch Fan Actuation System Detail Design Report
NASA CR-134873	QCSEE Ball Spline Pitch Change Mechanism Design Report

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